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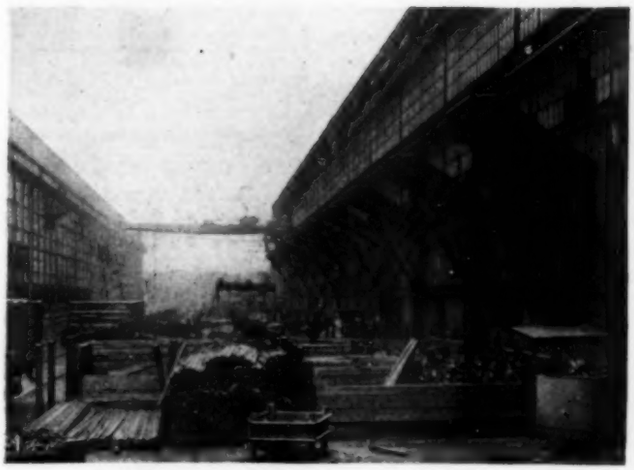

Fig. 1—A section of the yard outside the forge shop showing stored material and mezzanine delivery chutes along building
Fig. 2—The mezzanine furnace deck, showing how material comes in from the chutes outside of the building

Studebaker Methods of FORGING AND HEAT-TREATING

By Frank J. Oliver, Jr.
Western Editor, American Machinist

Throughout the forge shop, the arrangement of the equipment is such that there is an even flow of material between machines and furnaces

FORGING and heat-treating are so definitely associated at the Studebaker plant in South Bend, Indiana, that it is almost impossible to talk of one without mentioning the other. In most cases the heat-treating equipment is installed in the forge department and in more than one instance is an integral part of the production line turning out a certain part such as a crankshaft or rear axle. A number of unusually interesting layouts are to be found in this plant. In order to illustrate them, a few typical parts will be followed through their course of manufacture from the billet into the finished forging ready for machining.

Material for forged parts enters the plant in the form of rods, billets, and plates, and is stored in a yard adjacent to the forge shop. In Fig. 1 a portion of this yard is shown. In the distance may be seen one of the shear houses, of which there are two, one at each end of the yard, both served by a single overhead bridge crane with a large electric lifting magnet. The magnet is used to lift the stock out of the railroad cars, stack it in the yard, convey the bundles of stock to the shear houses, and also to pick up the sheared ends, which are carried on flat-flight steel conveyers from each shearing machine to a pit just outside the respective sheds.

For certain classes of small work, it has been found most convenient to arrange the forging furnaces on a mezzanine floor above the forging machines. This arrangement not only permits a more unrestricted use of floor space about the hammers, but also keeps the furnace heat away from the machine operators. In this case the sheared stock is dropped by the electromagnet into chutes on the outside of the forge shop shown at the right in Fig. 1. These chutes, which are about 25 ft. above the yard level, deliver the material to the furnace decks shown in Fig. 2, which, as just stated, are on a mezzanine located about 15 ft. above the general floor level. The

furnaces are oil-fired and are fed by hand. In the illustration, Fig. 2, the furnace tender may be seen holding a heated piece in the tongs just over one of the secondary and smaller chutes by means of which the material is conveyed to the steam hammers below. These hot-delivery chutes are curved like a roller coaster and are hyperbolic in shape. The red-hot piece comes down the chute at a rapid rate and is brought to a dead stop by a shoulder on the stock table. Incidentally, the shock of stopping aids in removing the scale from the piece before it is placed in the forging machine. A typical section of the general floor arrangement is shown in Fig. 3, a partial diagrammatic layout.

The hammers shown in this layout are all of the steam type, and the presses are for the hot shearing of the fin from the material. The trimmed pieces are thrown into steel baskets and are later conveyed by an overhead bridge crane across to the heat-treating furnaces, which Fig. 3 also shows. The heat-treating operations from this point on are the same for several typical forgings, and will be described later in the article.

Another interesting layout of machine equipment is seen in the arrangement for producing rear axles. The completed rear axle for the "Dictator 6" model is shown in Fig. 4, as well as the rough forging outline. This axle

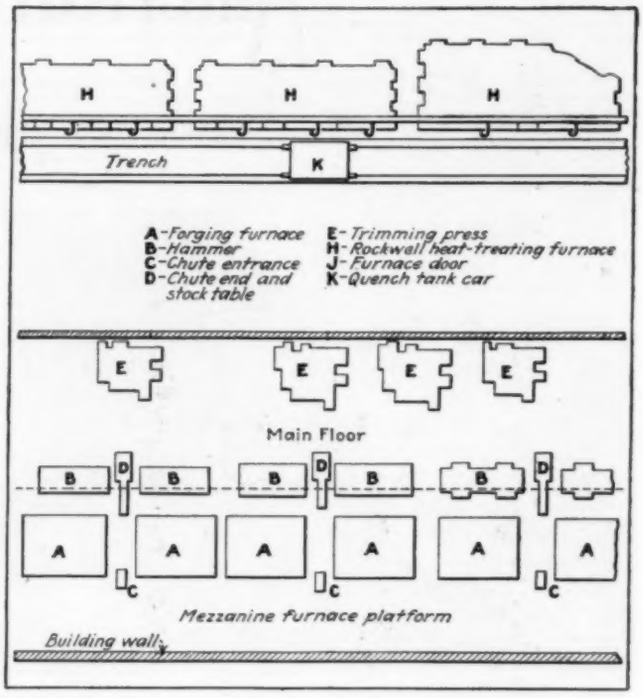

Fig. 3—Floor plan of a section of the forge shop showing location of furnaces on the mezzanine deck relative to the hammers and trimming presses below. The heat-treating furnaces are likewise close to the forging presses

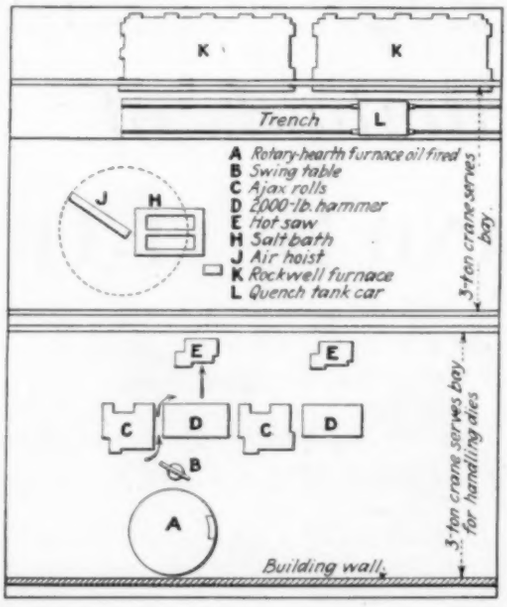

Fig. 5—Floor plan of a section of the forge shop showing the arrangement of the furnaces and machines for forging and heat-treating Studebaker rear axles. The arrangement is such that a minimum of handling is required and the forging may be passed from one machine to the next. The only mechanical transportation necessary is by crane across to the heat-treating furnaces. The drawing unit may also be seen. The quench car, into which the parts are placed after coming from the hardening furnace, runs on tracks passing in front of the furnaces

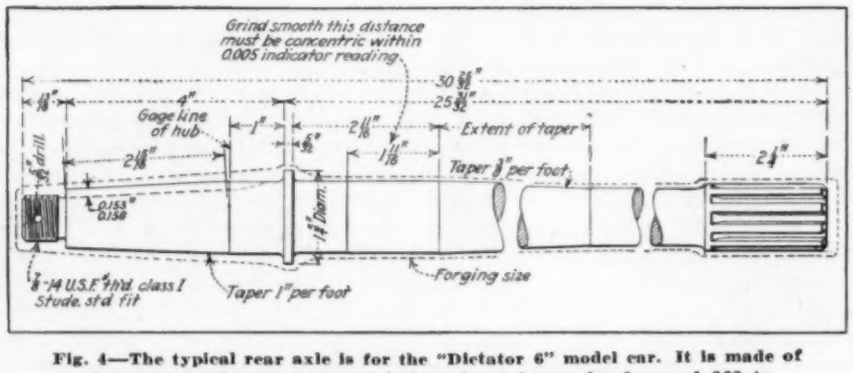

Fig. 4—The typical rear axle is for the "Dictator 6" model car. It is made of chrome-molybdenum steel and is heat-treated to a hardness of 363 to 402 Brinell. The rough forging outline is shown by the dotted lines and the machine-finished outline by the full lines

is typical of other rear axles that are larger in size. The forge furnace, shown at *A* on the layout of the equipment in Fig. 5, is of the rotary-hearth type and is oil-fired. It is located on the ground floor immediately adjacent to the yard so that the crane with its electromagnet can deposit the sheared bar stock just outside the doorway and within a few feet of the furnace. Cold pieces are charged by hand, and the heated bars are withdrawn by tongs. The furnace operator places the piece on the turntable *B* from which the first machine operator picks it up. The first operation is to shape one end of the axle in the Ajax rolls *C*. The piece is reversed by placing it on the turntable and giving it a swing. The other end is then similarly shaped on the same machine, but in a different set of dies, of which there are four.

From this operation the part is thrown on a shelf between the roll and the 2,000-lb. steam hammer *D*, where a third operator picks it up. This hammer is used to strike the axle into final shape. The axle then goes across to the double-ended hot saw *E*, where the same operator

places it in a fixture in a carriage and by means of a rack and lever movement advances it into the saws. This operation trims off the tong-holding end and cuts the axle to length. It is then ready for normalizing, after which it is rough machined and returned to the forge shop for final heat-treating. Three men, including the furnace operator, finish about 39 forgings per hour with this set-up. In Fig. 6 is shown a photograph of the machine layout lettered to correspond with Fig. 5 so as to identify the equipment. In the rear of the picture may be seen the Rockwell hardening furnaces with quench cars in front of two of the furnaces.

These Rockwell furnaces are oil-fired, and the axles are heated in them to about 1,525 deg. Fahrenheit. They are then raked out by hand into quenching-tank cars that run on tracks in front of the furnaces. Cold water flows continuously through the quench car from convenient taps along the furnace line and hence a complete furnace charge may be dumped into the car without overheating the water.

In certain instances, for example, in the case of small forgings made in the furnace combination just described, the parts are hauled out on the floor and cooled in air instead of being quenched. In the case of the axles, a draw operation, of course, is necessary after the cold water quench, and a salt bath, shown in Fig. 7, is used for this purpose. The cold axles are placed in baskets made of steel bands. The baskets are then lowered in the salt baths, of which there are four, by means of an air hoist suspended from a pivoted jib crane. These axles are heated to a temperature between 800 and 900 deg. F., are held at this point for about 20 min. and then cooled in water. The quench tank may be seen in the illustration immediately in front of the jib crane post. At the right is the recording pyrometer for controlling the temperature of the salt bath. The material used for these axles is a chrome-molybdenum steel, and a Brinell hardness ranging between 363 and 402 is specified.

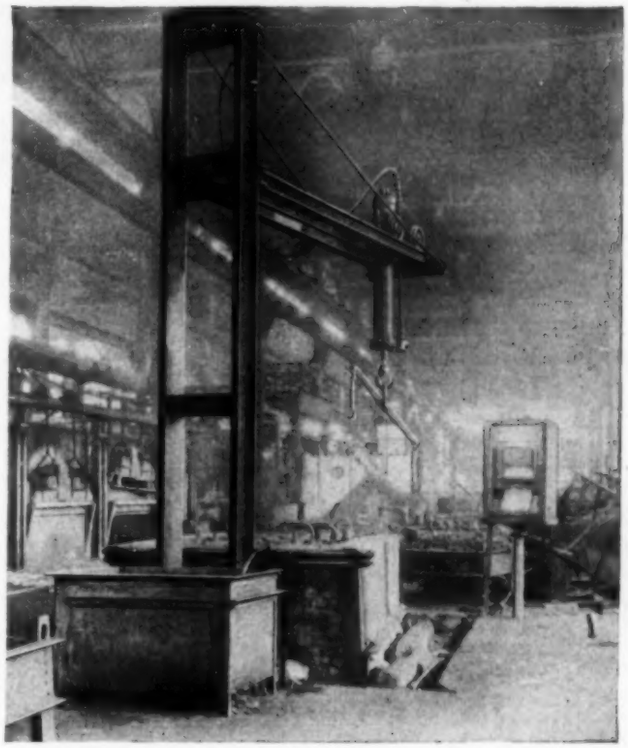

Fig. 7—After heating in chamber-type furnaces and quenching in cold water, the rear axles are drawn in the salt bath shown. The air hoist on the jib crane is used for handling the parts, which are carefully piled in baskets. Recording-pyrometer control is used to maintain the temperature of the bath at the correct point

Certain parts, like the rear axle pinion or third member, are upset and cut off in heading machines and are later trimmed in presses. Such parts are also normalized in the Rockwell furnaces and are held at about 1,700 deg. F. for 3½ hours, then cooled in air and later drawn in the same type of furnace at a temperature of about 1,200 deg. Fahrenheit. They are then quenched in water to help break the scale and to aid in cleaning. The material used is a high-chrome-nickel steel having a fairly low carbon content.

The forging of a more complicated part, such as a front axle, is more involved than the operations on some of the simple parts just described and because of the extra steps performed requires additional equipment. In Fig. 8 is shown the floor plan of the layout for producing these front axles. The material is SAE 1040 steel, which is sent to the forge room in the form of square billets cut to length. The first operation is to heat one end at a time in furnace *A* and to upset it in a heading machine *B*. The process is repeated to upset the other end. The part is then transferred by a monorail conveyor to

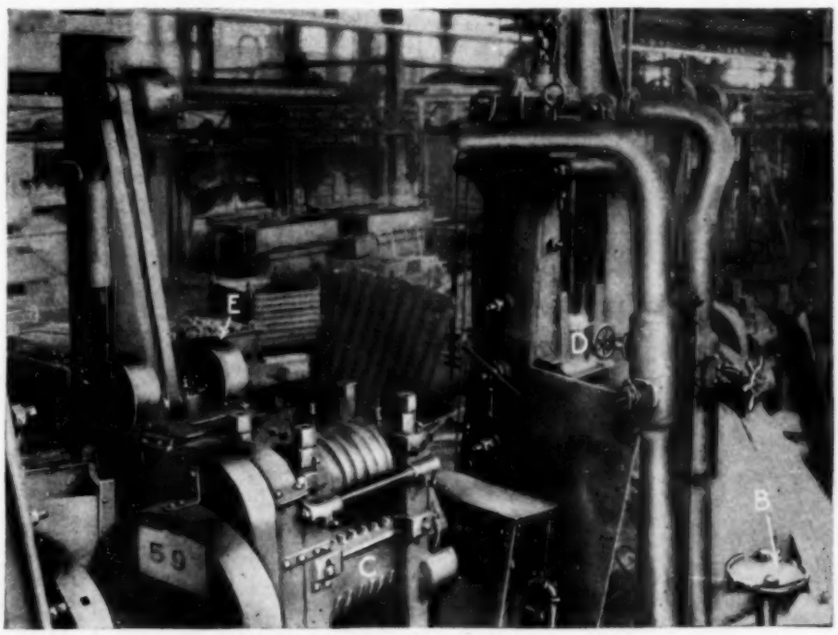

Fig. 6—Machine equipment used in the forging of rear axles. The photograph is lettered to correspond with the symbols on Fig. 5, showing the floor plan

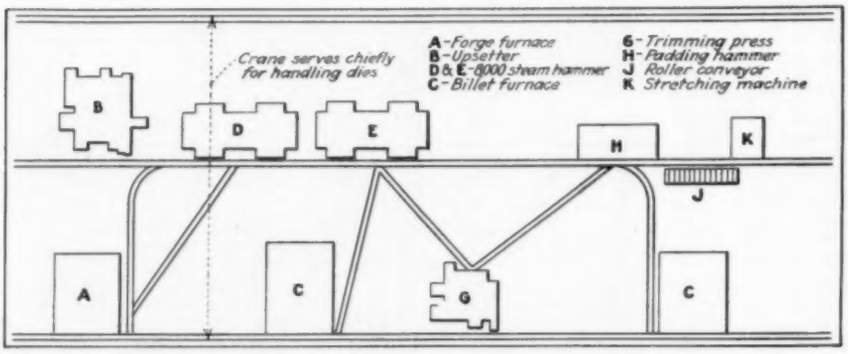

Fig. 8—A section of the Studebaker forge shop showing the layout of the equipment for producing front axles. The conveyor system indicated consists of overhead I-beams carrying a four-wheel buggy from which a chain sling is suspended

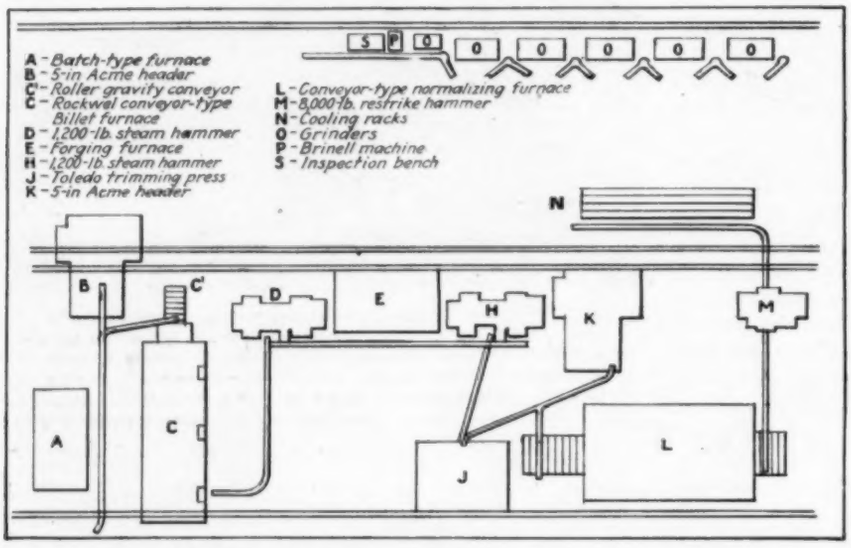

Fig. 9—A floor plan of the section of the forge shop devoted to crankshaft forging. An overhead monorail conveyor serves all machines. For handling dies in and out of the machines, a 3-ton bridge crane is employed

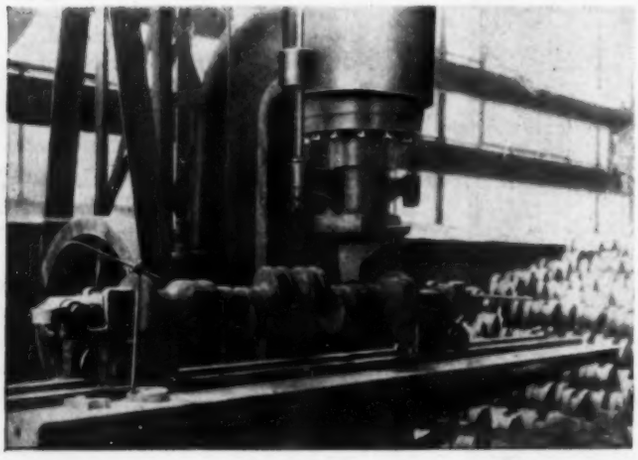

Fig. 10—All crankshafts must be straightened to within 1/32 in. runout on the throws and at the bearings. A hydraulic press is used, and the piece is held on centers in two carriages connected by a tie-rod. Only 20 per cent of the crankshafts are out more than 1/16 inch

billet furnace *C* where it is completely heated. The next forging operation is to break down the upset billet in the hammer *D* and to forge it to final shape in hammer *E*. Both hammers are of the steam type and are rated at 8,000 lb. capacity. While still hot, the rough forging is placed in the trimming press *G* and the fins are removed.

From the trimming press the axle goes to the padding hammer *H* where the spring pads are forged to final shape. Without further heating the axle is pulled from the padding machine and is thrown on roller conveyor *J* from the lower end of which it is picked up and placed in the stretching machine *K* for pulling the spring pads apart to their final position. The forging dies are designed so that about 1 in. of stretch is necessary in this final operation. In this forging line-up about 30 front axles are completed per hour.

The heat-treating process consists of normalizing, cooling, reheating, quenching in water and drawing at about 1,000 deg. Fahrenheit. Before the piece is allowed to cool it is usually restruck at the drawing heat. These operations are carried out in automatic conveyor-type furnaces. Further operations on the front axle include spot grinding for Brinell reading, making and checking the Brinell impression, cold straightening and squaring up, pickling and lastly priming, or applying oil.

Perhaps the most interesting and complete layout is that for forging both Studebaker and Pierce-Arrow crankshafts. In one section of the forge shop is concentrated all the equipment necessary to forge the crankshaft and to deliver it completely heat-treated to the pickling machine. This simplification of layout is attained through the use of a special carbon steel with a small, but important, vanadium content, instead of the SAE 1045 steel commonly employed for this type of work.

With this special steel, by means of the simple procedure of normalizing and cooling in air, the same physical properties may be obtained as are available in SAE 1045 steel, which must be quenched and drawn after normalizing. Furthermore, because of this single, simple heat-treatment, the crankshafts actually hold their shape much better after subsequent machining operations, since there are no quenching strains to be relieved.

In Fig. 9 the floor plan layout for forging crankshafts is shown. For the "President 8" model, the steel comes in the form of billets $4\frac{1}{8}$ in. in diam. by 48 in. long. One end of the stock is heated in an automatically-controlled, batch-type furnace *A* for the upsetting operation in the Acme header *B*, which puts a collar $\frac{3}{4}$ in. high by $1\frac{1}{4}$ in. wide on the shaft in order to facilitate forging a flange

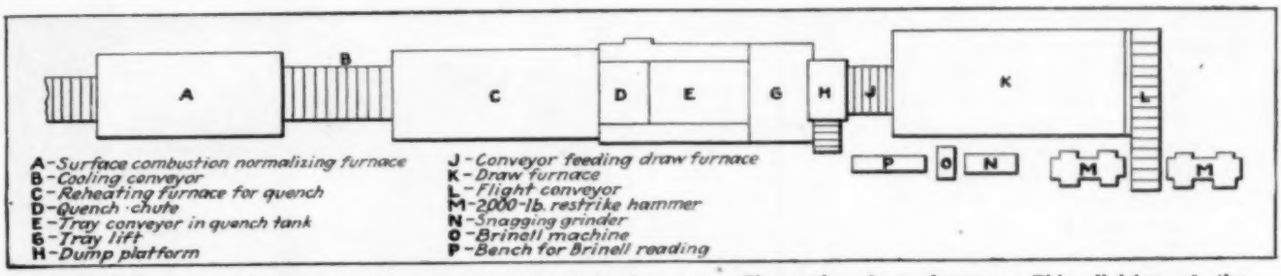

Fig. 11—Floor plan of the Surface Combustion automatic heat-treating unit used for connecting rods, steering knuckles and steering arms. The work travels progressively by conveyor but must be rehandled to be placed in the draw furnace. This division of the equipment is necessary because some parts are cleaned before drawing

on the front end of the shaft. This flange holds a vibration damper flywheel. Next the stock is transferred by an overhead monorail conveyor to a continuous gravity-feed billet furnace. In this furnace *C* it is heated to the correct temperature for the following forging operation in which the billets is broken down in the 1,200-lb. steam hammer *D*. During this process its temperature falls 400 deg., so that the piece must be reheated in the booster furnace *E*. This is a batch-type furnace and is also automatically controlled.

On this heat the final forging is done in steam hammer *H*, the fin is trimmed off in the crankshaft press *J*, and the main flywheel flange is upset in the Acme header *K*. The crankshaft is then ready for normalizing in the continuous pusher-type furnace *L*, which has a loading platform sufficiently long to allow the temperature of the piece to drop to about 950 deg. F. before it is reheated. The piece is in the furnace about $1\frac{1}{2}$ to $1\frac{3}{4}$ hours, but is held at the normalizing temperature of 1,650 deg. F. for only $\frac{3}{4}$ hour. At the discharge end of the furnace the cranks are pulled out and while still hot (above 1,600 deg. F.) are restruck twice in the 8,000-lb. steam hammer *M*, from which they go to the cooling racks *N*. These racks are made of eight 50-lb. rails spaced at about 6 in. center to center, and allow the cranks to cool in a straight position.

The grinders *O* are used for rough grinding the crankshafts by hand on snagging wheels. The crankshafts are then spot-ground for the Brinell impression made in machine *P* and read at bench *S*. Pickling is the next operation, performed in a Mesta pickling machine. Before they leave the forge shop, the crankshafts are centered for the straightening operation which follows in a hydraulic press, as Fig. 10 shows. Every

Fig. 12—Photograph of part of the automatic heat-treating installation diagrammed in Fig. 11, above. This view is looking at the discharge end of the normalizing furnace

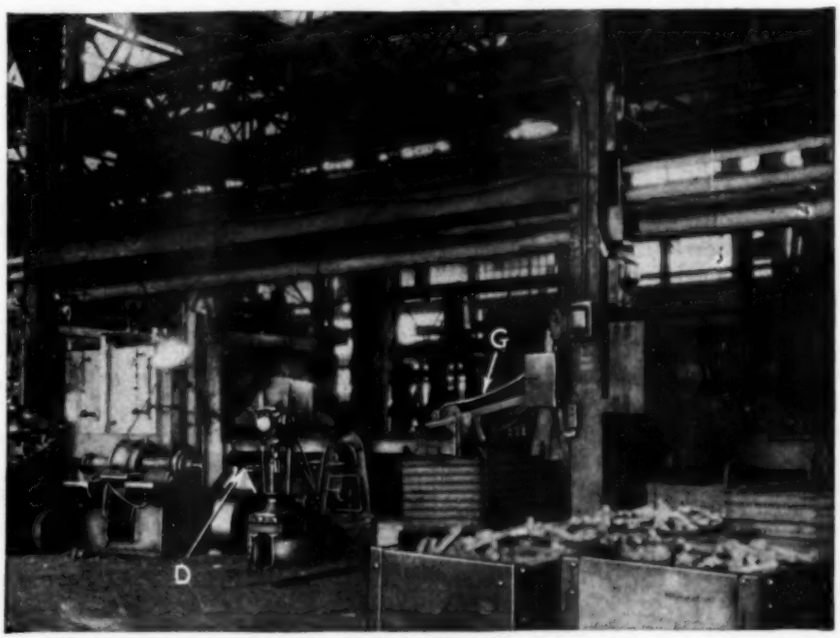

Fig. 13—A section of the automatic heat-treating unit of Fig. 11, showing the quenching stage. The trays, after dumping the work down chute D, are carried by chain G to the loading table for the draw furnace

crank must go through this straightening process to come within the limit of $\frac{1}{32}$ in. on runout on the throws and on the bearings, but only about 20 per cent of the product is found to be out more than $\frac{1}{16}$ in. The work of straightening after subsequent machining operations is only about one-quarter that necessary when regular SAE 1045 crankshaft steel was used.

Small forgings, such as connecting rods, steering knuckles and steering arms, are also formed in steam hammers but are heat-treated in the automatic Surface Combustion until illustrated in Fig. 11, which is a diagram of the layout. A photograph of the normalizing furnace portion of the machine is shown in Fig. 12, while Fig. 13 shows a close-up view of the quenching stage. There are five stages in the furnace: normalize, cool, heat for quench, quench, and draw. The work is loaded on trays and every $4\frac{1}{2}$ min. one tray enters the furnace. The capacity is 2,500 lb. of forgings per hour completely heat-treated. Only three men are required to operate the unit where formerly twenty men were employed to finish the same amount of work.

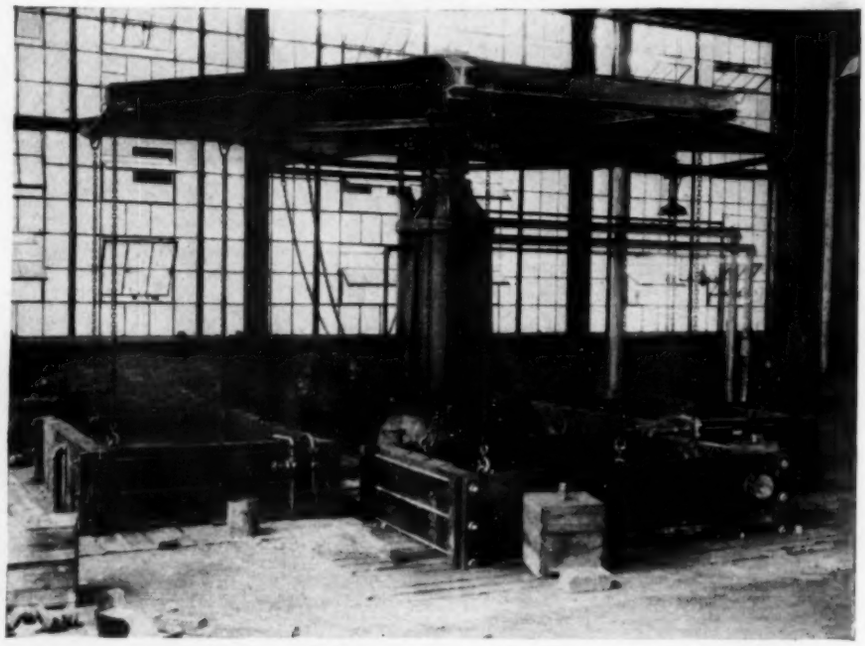

Fig. 14—A Mesta pickling machine is used for all pickling operations in the forge shop. Two acid dips and one hot-water wash are used. At the rear is the loading station. The center post is a hydraulic ram for raising and lowering the baskets

As an example of the work done on this unit, the details of the heat-treatment of a connecting-rod will be given. This is forged from SAE 1035 steel. In the first section of the automatic furnace *A* in Fig. 11, the piece is brought up to the normalizing heat of 1,650 deg. F. and held there for 15 min. It is then cooled in air and heated in another furnace *C* to about 1,525 to 1,550 deg. Fahrenheit. Up to and through this point the work has been carried on trays on a flat-flight conveyor. At this point the trays are tripped, the contents are dumped into a chute *D* and fall into a water-quenching tank. Another flight conveyor *E* picks up the quenched pieces and drops them on a table *H* just in front of the draw furnace for inspection. In the meantime the original trays travel forward empty and begin to enter the draw furnace, at which point they are again loaded by hand.

In the draw furnace *K* the connecting-rods are held at the drawing temperature for at least an hour before they reach cooler parts of the furnace and are discharged. A small flat-tray conveyor *L*, at right angles to the main conveyor line of the furnace at its end, then carries the parts to restrike hammers *M* immediately adjacent where they are restruck at the drawing temperature. These machines are 2,000-lb. steam hammers and, as can be seen from Fig. 11, two of them are used. Eventually the furnace trays are carried back to the starting point by an overhead conveyor system.

The next step is to examine a percentage of the product for hardness. Very important parts such as steering knuckles are Brinelled 100 per cent. Close to the restrike hammers is a snagging grinder *N* where each part is spot-ground for the Brinell impression that is made on a machine *O* immediately adjacent. On the other side of the Brinell machine is a table *P* where two operators measure the diameter of the impression under a hand-type measuring microscope. Pieces that fall outside the specified hardness range are sent through the draw furnace a second time. As in the case of the front axle, the pieces are then pickled and rustproofed by dipping in oil.

A standard Mesta pickling machine is used, and as shown in Fig.14, it carries four baskets. One stage is a loading position, two are acid dips and the last is a hot-water dip. The acid tanks are cleaned of sludge once a weeek, and a check on the acid strength and iron content is made twice a day by laboratory assistants.

Getting Workers to Obey Rules

By Harry Kaufman

A DISTINCTION should be made between shop rules that apply to routine and those that involve safety. The reason for an administrative rule may not always be entirely clear to the workman, and hence he may violate it unintentionally without a proper understanding of its necessity. Definite advantages may be gained by explaining the reason for the rule in such a case. This explanation may save a valuable workman to the organization, and also open up to him a new viewpoint.

Safety rules should be distinctly set off from the foregoing rules. They not only involve the individual's own safety and well-being, but the protection of his fellow-workmen, as well. The violation of such rules is serious and must not be tolerated. The man who breaks them is a menace to himself and the organization, an ever-present source of danger to other employees. If he refuses to take heed of warnings he should be discharged. It may seem harsh to dismiss him, but the situation seldom leaves any other alternative.

Heat-Treatment of AIRPLANE PARTS

By R. E. Johnstone
Engineer, Boeing Airplane Company

HEAT-TREATING, which has played such an important part in the development of the modern automobile, is fully as necessary in the successful construction of modern aircraft. But while much that has been developed by the automobile industry is of value to the builder of aircraft, new methods of heat-treatment, and new types of heat-treating apparatus have been necessary to secure the desired results in aircraft construction. This is particularly true in the case of the lighter alloys that use aluminum as a base, such as that commonly known as Duralumin, or "dural." Alloys with a variety of properties are made by various companies and have special designations, but, to the shop man at least, the general term "dural" covers them all, even though incorrectly. More accurate designation will, however, be made in this article.

Heat-treatment receives special consideration in the Seattle plant of the Boeing Airplane Company, every steel part that enters into the manufacture of their airplanes being routed through the specially equipped heat-treating department. Only in this way can maximum strength with minimum lightness be secured, a most important consideration in modern airplane construction.

Fig. 1—Heating bath for airplane parts. The solution used is that of a mixture of potassium and sodium nitrate, and is heated by gas. The tank is 11 ft. in length

The heat-treating department for steel, adjoins the machine shop, and is equipped with three electric furnaces, thermostatically controlled. These furnaces are 3, 5 and 10 ft., respectively, in interior lengths, and can accommodate the varied sizes of steel parts required for airplanes. The equipment also includes an auxiliary gas oven, 5 ft. in length, which is used only when the maximum production capacity of the electric furnaces is exceeded. One of the electric furnaces used is seen in Fig. 2. Chrome-molybdenum, and nickel are the steel alloys generally used in the fabrication of aircraft. Parts manufactured of chrome - molybdenum steel are treated to a maximum heat of 1,625 deg. F. and nickel-steel parts are subjected to a maximum temperature of 1,500 deg. F. The temperatures of the furnaces are charted on a graph by a recording pyrometer.

The duration of the treatment depends upon the size and thickness of the part and the type of metal under treatment. When the parts have remained in the furnaces for the proper length of time, they are quenched in a bath of oil. The oil in this tank, which has a capacity of 220 gal., is kept at the desired temperature by being circulated through a cold water tank by means of an electric pump. After hardening, the parts are replaced in the furnaces for a secondary heating with the temperature considerably less than the maximum for the original heat treatment in the furnace.

Chrome-molybdenum steel is being used widely in aircraft construction, and its tempering requires closer temperature control than is usually thought necessary in automotive work, while the heat-treatment of large aluminum sheets 0.0179 in. thick demands refinements beyond those ordinarily considered practical

At the conclusion of the heat-treatment, the parts are sent to the metal inspection booth, where both government and company inspectors examine them minutely for defects.

A reasonably large quantity of aluminum and alu-

Fig. 2—One of the electric furnaces employed for heating the molybdenum steel parts. These furnaces are 3 and 5 ft. in depth. There are three in all

minum alloy is used in the production of aircraft. The advantages of this type of metal are its relative lightness and strength. Aluminum, Duralumin, and Alclad are used extensively for surfaces, coverings, cowling, seats, flooring, tanks, and similar parts, as well as for structural tubing and strut work. All aluminum-alloy parts are heat-treated for hardening and toughening, this being done in the sheet-metal heat-treatment section, which adjoins the sheet-metal department. This heat-treating department is equipped with three heat-solution bath tanks, which are 5, 11, and 16 ft. in interior lengths. Beside each heating-bath tank is a cold water tank of corresponding size, which is used for quenching after the heat-treatment.

The heating tanks contain a solution of potassium and sodium nitrates, which is kept at a maximum temperature of 950 deg. F. The solution is heated by a mixture of gas and air, the pipes being coiled in the base of the tanks. In Fig. 1 one of these tanks is seen.

The duration of the heat-treatment varies from 9 to 28 min., the former for metal 0.0179 in. in thickness, and the latter for metal 0.2043 in. thick. A test strip cut from the same stock as the consignment of parts under treatment is immersed at the same time, and at the completion of the heating and quenching processes this test piece is referred to the testing department, which tests it for strength. Duralumin, for example, is expected to test up to 56,000 lb. per square inch. No part may be used unless it has first been approved by the board of inspectors consisting of both company and government men at the plant.

IT OFTEN is best not to ask a manufacturer to punch holes through leather packing for hydraulic presses. This is especially true if it is intended to keep the packing in storage for a while, because even the best leathers shrink or change shape so that, after a while, the holes in the gaskets will not match the bolts in the piston. When the user finds that the holes do not match the bolts, he is inclined to blame the manufacturer, whereas, the manufacturer may not be to blame at all. Therefore, unless the packing is to be used immediately it is better for the user to cut the bolt holes himself.

Indicating "Up" and "Down" on Hoists

By H. Ezra Eberhardt
Gould and Eberhardt

I HAVE noticed many times, in walking around our shop, that considerable time is lost when the workmen are using the electric hoists. It is always confusing to the workmen to know just which rope to pull in order to have the hoist go upward or downward, and I have repeatedly seen a workman first try one rope, and when he found it went in the opposite direction to which he wished the load to proceed, he had to pull the other rope. This doubt as to which rope to pull occurs even though each handle is labeled "up" and "down" respectively. The trouble is the man does not take time to look at the nameplate, but immediately proceeds to pull one of the ropes, and unless he has been previously operating the hoist within the past few minutes he forgets which one to pull.

A very simple idea, but one that has proved practical and efficient in the operation of these small hoists, is to shorten the rope that operates the lift motion of the hoist so that when a workman wishes to have the hoist go upward, all he looks at is the rope that is higher than the down rope, and he pulls the correct rope with the assurance that the hoist will go upward. On the other hand, if he wishes the hoist to go downward, all he has to think of or look at is the rope that is lower than the other rope, and he pulls it with the assurance that the hoist will go downward.

Steel Piston Rings—*Discussion*

By J. T. Towlson
London, England

THERE seems to be no general solution of the problem as to whether steel piston rings are better than cast-iron, referred to by John R. Godfrey on page 809, Vol. 70. It depends in a measure upon the dissimilarity of the metal composing the rubbing surfaces. I have found that with soft cast-iron rings working in a soft cast-iron cylinder, both will wear out in a short time. With the rings soft and the cylinder hard and with average lubrication the life is considerably longer. With conditions reversed the life is not nearly as long. With steel rings, not machinery steel full of manganese but of good grade, and a cylinder of good gray cast-iron the chances for long life are good. "Unlikeness" seems to be the secret of success, in this case as in some others in different fields.

I have had some experience with an underwater job in the manufacture of golf balls, the working parts being all non-ferrous so as to be non-corrosive. When the spindles of the machinery were made of cast phosphor bronze and the bearing bushings of similar metal, their life was very short. But when the spindles were made of cast phosphor bronze and the bearing bushings of soft, "full" copper, rolled phosphor-bronze, or vice versa, their life was considerably longer.

Just fifty years ago I designed and constructed a 10x12-in. vertical engine. The shaft was made of fairly soft cast-iron with a high tensile strength, and the bearings of extra-hard cast-iron with no bushings and just double the usual length. That engine is running today. The bearings are like glass and have never been renewed. They seem as good as new.

American Machinist

NATIONAL METAL CONGRESS
SECTION

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Program of Technical Sessions

American Society for Steel Treating

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MONDAY MORNING

Ball Room, Cleveland Hotel

Dilatation of Steel During Quenching—G. M. Eaton, Molybdenum Corp. of America.

Economical Re-Use of Solid Carburizing Materials—H. B. Knowlton, International Harvester Co.

Selection of Case-Hardening Steels for Highly Stressed Gears—H. W. McQuaid, Timken-Detroit Axle Co. O. W. McMullan, co-author.

MONDAY AFTERNOON

Meeting Room, Public Auditorium

Conditions Necessary for Blistering of Metal During Processing—Dr. Anson Hayes. Dir. of Res., American Rolling Mill Co.

Dendritic Steel—H. G. Keshian, Chase Metal Works.

Improving of Refractory Lining of Heat Treating Furnaces for High Temperature Annealing of Steel Castings—W. J. Merten, Westinghouse Electric & Manufacturing Co., East Pittsburgh Works.

Overheating of Steel for Forging—W. E. Jominy, Univ. of Michigan.

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TUESDAY MORNING

Ball Room, Cleveland Hotel

Production of Electric Steel for Castings—George Batty, Res. Dir. Stl. Cstgs. Dev. Bur.

Slags Produced in Steel Making, Their Effects on the Product and on the Process Itself—G. A. Dornin, Gathmann Engrg. Co.

Melting Practice for Three Types of Electric Steel—H. P. Rassbach, Open-hearth Dept., Midvale Steel Co., Nicetown Works.

Locomotive Forgings—Lawford H. Fry, Prod. Supt., Standard Steel Works.

TUESDAY AFTERNOON

Meeting Room, Public Auditorium

Methods of Tests for Determining the Machinability of Metals in General, with Results—O. W. Boston, Dir. of Engr. Shops, Univ. of Mich.

Distribution of Hardness Produced by Cold Working—W. P. Sykes, Metallurgical Engr., General Electric Co. A. C. Ellsworth, co-author.

Inherent Hardenability Characteristics of Tool Steel—B. F. Shepherd, Ingersoll-Rand Co.

Notes on the Behavior of Carbon Tool Steel on Quenching—G. V. Luerssen, Carpenter Steel Co.

WEDNESDAY MORNING

Ball Room, Cleveland Hotel

Steel at Elevated Temperatures—Albert Sauveur, Harvard University.

WEDNESDAY AFTERNOON

Joint Meeting with Institute of Metals

Meeting Room, Public Auditorium

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THURSDAY MORNING

Ball Room, Cleveland Hotel

Hot Aqueous Solutions for the Quenching of Steels—H. J. French, International Nickel Co. T. E. Hamill, co-author, U. S. Bureau of Standards.

Study of the Iron-Chrome-Carbon Constitutional Diagram—Dr. V. N. Krivobok, Carnegie Inst. Tech. M. A. Grossmann, co-author.

Non-Destructive Testing—E. A. Sperry, Sperry Development Co., Inc.

Brittle Range in 18—8 Chrome-Nickel Iron—H. H. Lester, Watertown Arsenal.

THURSDAY AFTERNOON

Meeting Room, Public Auditorium

Graphitization of Prequenched White Cast Iron—H. A. Schwartz, National Malleable & Steel Castings Co. H. H. John and C. H. Junge, co-authors.

Austenite and Its Decomposition—Albert Sauveur, Harvard Univ.

High-Strength Cast Iron—E. J. Lowry, Cons. Metallurgist.

Crystal Structure of an Iron Phosphide—James B. Friauf, Bur. of Met. Res., Carnegie Inst.

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FRIDAY MORNING

Ball Room, Cleveland Hotel

White Layer in Gun Tubes—H. H. Lester, Watertown Arsenal.

Observation Upon the Iron-Nitrogen System—Samuel Epstein, Illinois Steel Co.

Study of the Nitriding Process—V. O. Homerberg, Mass. Inst. Tech. Dr. Walsted, co-author.

Researches on Nitriding Steels—Dr. O. E. Harder, Univ. of Minn. J. T. Gow and L. A. Willey, co-authors.

FRIDAY AFTERNOON

Meeting Room, Public Auditorium

Investigations in Nitriding—Robert Sergeson, Central Alloy Steel Corp.

Short Time Nitriding of Steels in Molten Cyanides—A. B. Kinzel, Union Carbide & Carbon Res. Lab. J. J. Eagan, co-author.

A Few Practical Fundamentals of the Nitriding Process—H. W. McQuaid, Timken-Detroit Axle Co. W. J. Ketcham, co-author.

American Welding Society

TUESDAY MORNING

Hotel Statler

Effect on Design of the Use of Welding in the Manufacture of Electric Machinery—H. G. Reist, General Electric Co.

Cutting and Welding Steel Parts to Replace Castings—W. F. Buchanan, Bessemer Gas Engine Co.

TUESDAY AFTERNOON

Public Auditorium

Welding of Copper and Copper Alloys—I. T. Hook, Res. Lab., American Brass Co.

Welded High-Strength Aluminum Alloys for the Aircraft Industry—J. R. Dawson, Res. Lab., Union Carbide & Carbon Co.

How To Test Welds—F. G. Tatnall, Southwark Foundry & Machine Co.

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WEDNESDAY AFTERNOON

Public Auditorium

Study of Nitride Needles—P. Alexander, General Electric Co.

Chemical Reactions of the Carbon Arc—G. E. Doan and E. Ekholm, Lehigh Univ.

Metallographic Study of Some Metal Arc Welds—H. M. Boylston, Case School of Applied Science.

Metallographic Studies of Welding and Cutting—M. Yatsevitch, Watertown Arsenal.

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THURSDAY MORNING

Hotel Statler

Gas Welding of Steel Buildings—H. H. Moss, Linde Air Products Company.

Stress Strain Characteristic of Welded Joints—J. H. Smith, University of Pittsburgh.

Non-Destructive Testing of Welds with the Stethoscope and X-Ray—C. O. Burgess, A. B. Kinzel and A. R. Lytle, Union Carbide & Carbon Res. Lab., Inc.

Welding Studies at the Watertown Arsenal—Major J. B. Rose, Ordnance Dept., U.S.A.

THURSDAY AFTERNOON

Joint Technical Session with A.S.M.E.

Public Auditorium

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FRIDAY MORNING

Hotel Statler

Oxy-Acetylene Welding Pipe Lines in the Field—W. R. Ost, Air Reduction Sales Co.

Electric Welding of Field Joints of Oil and Gas Pipe Lines—H. C. Price, Welding Engineering Co.

Welding of Tubing and Pipes for Locomotives and Boilers—H. A. Woofter, Swift Electric Welder Co.

Iron and Steel Division, A.I.M.E.

TUESDAY AFTERNOON

Public Auditorium

Change in Microstructure of Iron at the A_3 Transformation Points—B. A. Rogers, Western Electric Co.

New Development in Wrought Iron Manufacture—James Aston, Carnegie Inst. Tech.

Viscosity of Blast Furnace Slags—R. S. McCaffery, Univ. of Wis.

WEDNESDAY MORNING

Hotel Cleveland

Fluorspar and Its Uses—Earl Brokenshire, Oglebay, Norton & Co.

Foreign Iron Ores—Charles Hart, Delaware River Steel Co.

Iron Ore Sinter—G. M. Schwartz, Univ. of Minn.

Bradley Process for the Beneficiation of Magniferous Ores—Carl Zapffe, Northern Pacific Railroad.

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THURSDAY AFTERNOON

Public Auditorium

Diffusion of Iron Oxide from Slag to Metal in the Open-Hearth Process—C. H. Herty, Jr., U. S. Bur. Mines.

Experimental Determination of Equilibrium in the System Carbon FeO in Molten Iron—A. B. Kinzel and J. J. Egan, Union Carbide & Carbon Res. Lab.

Rate of Carbon Drop and Degree of Oxidation of the Metal Bath in Basic Open-Hearth Practice, II—A. L. Feild, Union Carbide & Carbon Co.

Institute of Metals Division A.I.M.E.

TUESDAY MORNING

Hotel Cleveland

Manufacture of Wire Bars from Secondary Copper—J. W. Scott and W. A. Scheuch, Western Electric Co.

Metal Recoveries in Secondary Aluminum Practice—R. J. Anderson, Fairmont Mfg. Co.

Reclaiming Non-Ferrous Scrap Metals at Manufacturing Plant—F. N. Flynn, Metlgst.

Utilization of Secondary Metals in Red Brass Industry—H. M. St. John, Detroit Lubricator Co.

Recovery of Waste from Tin Base Babbitting Operations—J. P. Potter, Federal Mogul Corp.

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WEDNESDAY AFTERNOON

Joint Meeting with A.S.S.T.

Meeting Room, Public Auditorium

Effects of Cold Working on the Physical Properties of Metals—R. L. Templin, Aluminum Co. of America.

Determining Orientation of Crystals in Rolled Metal from X-Ray Patterns—W. P. Davey, C. C. Nitchie and M. L. Fuller, N. J. Zinc Co.

Preparation of Microsections of Tungsten Carbide—S. L. Hoyt, General Electric Co.

Radiography as a Tool in the Metal Industry—W. L. Fink and R. S. Archer, Aluminum Co. of America.

Effect of Heat Treatment on Properties and Microstructure of Britannia Metal—B. Egeberg and H. B. Smith, International Silver Co.

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THURSDAY MORNING

Hotel Cleveland

Metallography of Commercial Thorium—Edmund S. Davenport, Westinghouse Lamp Works.

System Cadmium-Mercury—R. F. Mehl and C. S. Barrett, Naval Res. Lab.

Deoxidation of Copper with Calcium and Properties of Some Copper-Calcium Alloys—E. E. Schumacher, W. C. Ellis, and J. F. Eckel.

Causes of Cuppy Wire—W. E. Remmers, Western Electric Co.

An Investigation to Determine the Eutectic Composition of Copper and Tin—G. O. Hiers and G. P. deForest, Res. Lab., National Lead Co.

Notes on the Crystal Structure of Alpha Copper Tin Alloys—R. F. Mehl and C. S. Barrett, Naval Res. Lab.

Effect of Alloying on the Permissible Fiber Stress in Corrugated Zinc Roofing—E. A. Anderson, N. J. Zinc Co.

Iron and Steel Division, A.S.M.E.

WEDNESDAY AFTERNOON

Public Auditorium

DEVELOPMENTS IN BLAST FURNACES, DESIGN AND PRACTICE—Arthur G. McKee.

ORE-HANDLING BRIDGES—Alexander C. Brown, Industrial Brown Hoist Corp.

OIL ELECTRIC LOCOMOTIVES IN STEEL MILL TRANSPORTATION—W. L. Garrison, Ingersoll-Rand Co.

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THURSDAY AFTERNOON

Joint Session with American Welding Society

Public Auditorium

NON-DESTRUCTIVE TESTS OF WELDS—Elmer A. Sperry, Sperry Development Co., President, A.S.M.E.

FOREIGN PRACTICE IN WELDING BOILER TUBES AND DRUMS—George A. Orrak, Cons. Eng.

AUTOMATIC ARC WELDING OF THIN SHEETS—W. L. Warner, General Electric Co.

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FRIDAY MORNING

Hollenden Hotel

ALLOY STEELS IN IRON AND STEEL MILL EQUIPMENT—M. J. R. Morris, Central Alloy Steel Corp.

EVOLUTION OF DRIVES FOR MILL-TABLE ROLLERS—K. W. Feller, Schloemann Engr. Corp.

FRIDAY AFTERNOON

Joint Meeting with A.S.S.T.

Public Auditorium

DISTRIBUTION OF HEAT IN COMBUSTION FURNACES—M. H. Mawhinney, Electric Furnace Co.

ADVANTAGE OF PRODUCER GAS AS A FUEL COMPARED WITH OTHER FORMS OF FUEL—Victor Windett, Wellman, Seaver, Morgan Co.

POWDERED COAL CUPOLA—D. H. Meloche, American Radiator Co.

Outline of Events, National Metal Congress

MONDAY, SEPTEMBER 9

10:00 A.M.—A.W.S. Registration, Hotel Statler.
10:00 A.M.—A.S.S.T. Session, Hotel Cleveland.
12:00 M.—Exposition opens, Auditorium.
12:00 M.—A.W.S. and A.S.S.T. Men's Registration, Auditorium.
2:00 P.M.—A.W.S. Board of Directors, Hotel Statler.
2:00 P.M.—A.S.S.T. Technical Session, Auditorium.

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TUESDAY, SEPTEMBER 10

9:00 A.M.—A.I.M.E. Registration, Hotel Cleveland.
9:00 A.M.—I. of M. Registration, Hotel Cleveland.
9:15 A.M.—A.W.S. Session, Hotel Statler.
10:00 A.M.—I. of M. Session, Hotel Cleveland.
10:00 A.M.—A.S.S.T. Session, Hotel Cleveland.
2:00 P.M.—Visit to Case School of Applied Science.
2:00 P.M.—A.I.M.E. Session, Auditorium.
2:00 P.M.—A.S.S.T. Session, Auditorium.
2:00 P.M.—A.W.S. Session, Auditorium.
2:00 P.M.—A.S.T.M. Comm. B3, Subcomm. 6, Auditorium.
4:00 P.M.—A.S.T.M. Comm. B3, Subcomm. 7, Auditorium.
6:30 P.M.—Joint dinner, I. of M. and A.I.M.E., Hotel Cleveland.
9:30 P.M.—Grand Ball, Hotel Cleveland Ballroom.

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WEDNESDAY, SEPTEMBER 11

8:30 A.M.—A.W.S. Plant inspection, Hotel Statler.
9:00 A.M.—A.S.M.E. Registration, Hotel Hollenden.
9:15 A.M.—A.S.S.T. Plant inspection, Hotel Cleveland.
9:30 A.M.—A.S.S.T. Annual Meeting, Hotel Cleveland.
10:00 A.M.—A.W.S. Research Workers, Hotel Statler.
10:00 A.M.—A.I.M.E. Session, Hotel Cleveland.
10:30 A.M.—Campbell Memorial Lecture, Hotel Cleveland.
2:00 P.M.—A.W.S. Session, Auditorium.
2:00 P.M.—A.S.M.E. Session, Auditorium.
2:00 P.M.—I. of M. and A.S.S.T. Session, Auditorium.
4:00 P.M.—A.S.T.M. Comm. E4, Auditorium.
6:30 P.M.—Drop Forge Supply Ass'n Dinner.
7:30 P.M.—A.W.S. Struc. Steel Welding Comm., Hotel Statler.

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THURSDAY, SEPTEMBER 12

8:30 A.M.—A.S.M.E. and A.I.M.E. plant inspection, Auditorium.
9:15 A.M.—A.S.S.T. plant inspection, Hotel Cleveland.
9:30 A.M.—A.W.S. Session, Hotel Statler.
10:00 A.M.—I. of M. Session, Hotel Cleveland.
10:00 A.M.—A.S.S.T. Session, Hotel Cleveland.
1:30 P.M.—I. of M. plant inspection to Nela Park.
2:00 P.M.—A.S.S.T. Session, Auditorium.
2:00 P.M.—A.S.T.M. Comm. B3, Subcomm. 8, Auditorium.
2:30 P.M.—A.W.S. and A.S.M.E. Session, Auditorium.
4:00 P.M.—A.S.T.M. Comm. B3, Adv. Comm., Auditorium.
6:30 P.M.—A.W.S. Banquet and Dance, Hotel Statler.
6:30 P.M.—A.S.S.T. Annual Banquet, Hotel Cleveland.

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FRIDAY, SEPTEMBER 13

9:15 A.M.—A.S.S.T. plant inspection, Hotel Cleveland.
10:00 A.M.—A.W.S. Session, Hotel Statler.
10:00 A.M.—A.S.S.T. Nitriding Symposium, Hotel Cleveland.
10:00 A.M.—A.S.M.E. Session, Hotel Hollenden.
2:00 P.M.—A.W.S. Am. Bur. Welding, Hotel Statler.
2:00 P.M.—A.S.S.T. Nitriding Symposium, Auditorium.
2:00 P.M.—A.S.M.E. and A.S.S.T. Session, Auditorium.
6:30 P.M.—A.S.M.E. Banquet, Hotel Hollenden
10:00 P.M.—Exposition closes.

Exhibitors · Products · Representatives

National Metal Exposition

[Booth Numbers Follow Company Names]

—A—

Abrasive Co. 342 and 396. Red Center snagging wheel; abrasive wheels of Borolon, S. B. Borolon, Electrolon and Borolon grain.

S. M. Hershey, sales mgr.; John F. Guthrie, plant engr.; W. A. McMillan, factory rep.; I. R. Blair, adv. mgr.; R. A. Shaffer, v. p.; and J. F. Fischer, asst. sales mgr.

Acetylene Journal. 245.

Air Reduction Sales Co. 252 and 331. Airco 99.5 per cent oxygen and Airco acetylene in cylinders; Airco-Davis-Bournonville oxygen discharge manifold; Airco-Davis-Bournonville welding and cutting torches, regulators and supplies; Airco national carbide; No. 4-A Oxygraph. New No. 4 Camograph.

S. P. Fetter, dist. mgr.; G. J. Dekker, asst. dist. mgr.; H. L. Rogers; F. E. Rogers; T. M. Hamer; C. A. Daley; R. F. Helmkamp and F. J. Maeurer, eng. dept. and G. Van Alstyne, asst. adv. mgr.

Ajax Electrothermic Corp. 399. Model of 500-pound coreless induction furnace; polished section of ingot; two small laboratory coreless induction furnaces; moving picture of high-frequency (coreless) induction furnaces in operation.

Dudley Willcox, treas. and asst. gen. mgr.; and Robert N. Blakeslee, sec. and sales mgr.

Allegheny Steel Co. 70. Heat- and corrosion-resisting Ascoloy and Allegheny metal.

O. M. Otte; F. S. White; and Banks E. Eudy, engrs.

Allen Steel Co., Inc., Edgar. 284. Imperial Major high-speed steel; extra special high-speed steel; turning and finishing steels; Minerva air-hardening steel; special chisel steel; die casting steel; solid and hollow double six production steel; Class P tool steel; Stag tool steel; Talon tool steel.

Henry Sears Hoyt, pres.; J. King Hoyt, Jr., sec. and treas.; V. A. Green, v. p. and gen. mgr.; C. K. Everitt, dir. of Edgar Allen and Company, Ltd., Sheffield, England; E. R. Carnell, dir.; H. R. Adams, R. M. Brushingham.

Allied Products Corp. 274. Victor Peninsular Division, cold-headed products; Indiana Lamp Division, automotive lighting equipment; and Richard Brothers Division, replaceable and interchangeable punches and dies.

T. S. Higbee, sales engr., and J. E. Gladden, Pittsburgh rep.

Aluminum Co. of America. 334, 335, 336, 337. Ingots; forgings; castings; magnesium products; wire; rod; bar aluminum; tubing; conduit; pipe fittings; streamline tubing; aluminum foil; electrical conductors; transmission cable; collapsible tubes; extruded molding and structural shapes; shingles; radio parts; beams; window sash; doors; screw machine products; paint and bronze powder; welded chemical vessels; chairs; ladders; waste-baskets.

F. C. Shoupe, display mgr.

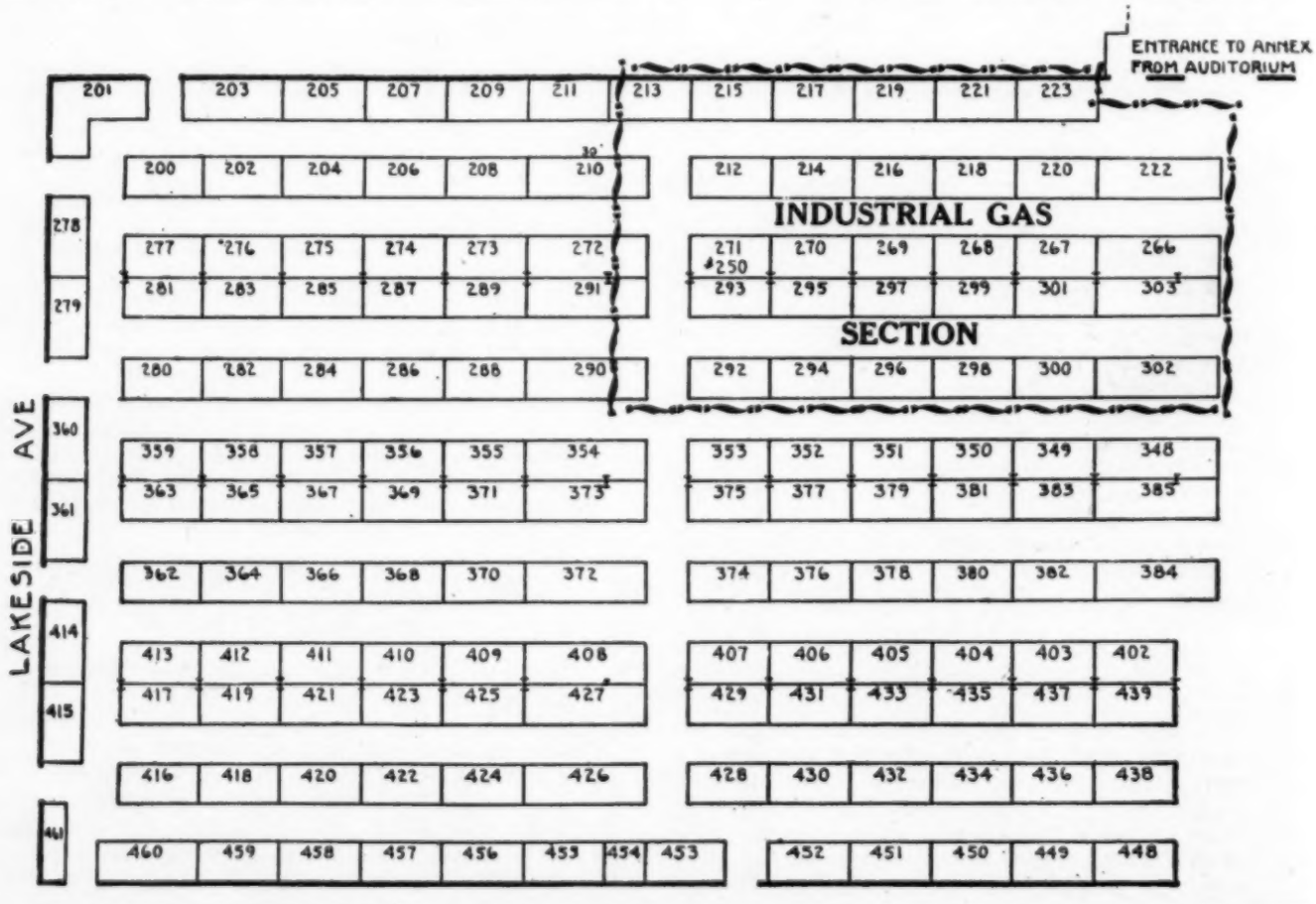
American Brass Co. 235. Tobin bronze and other Anaconda copper alloy welding rods; Everdur metal, copper-silicon-manganese alloy.

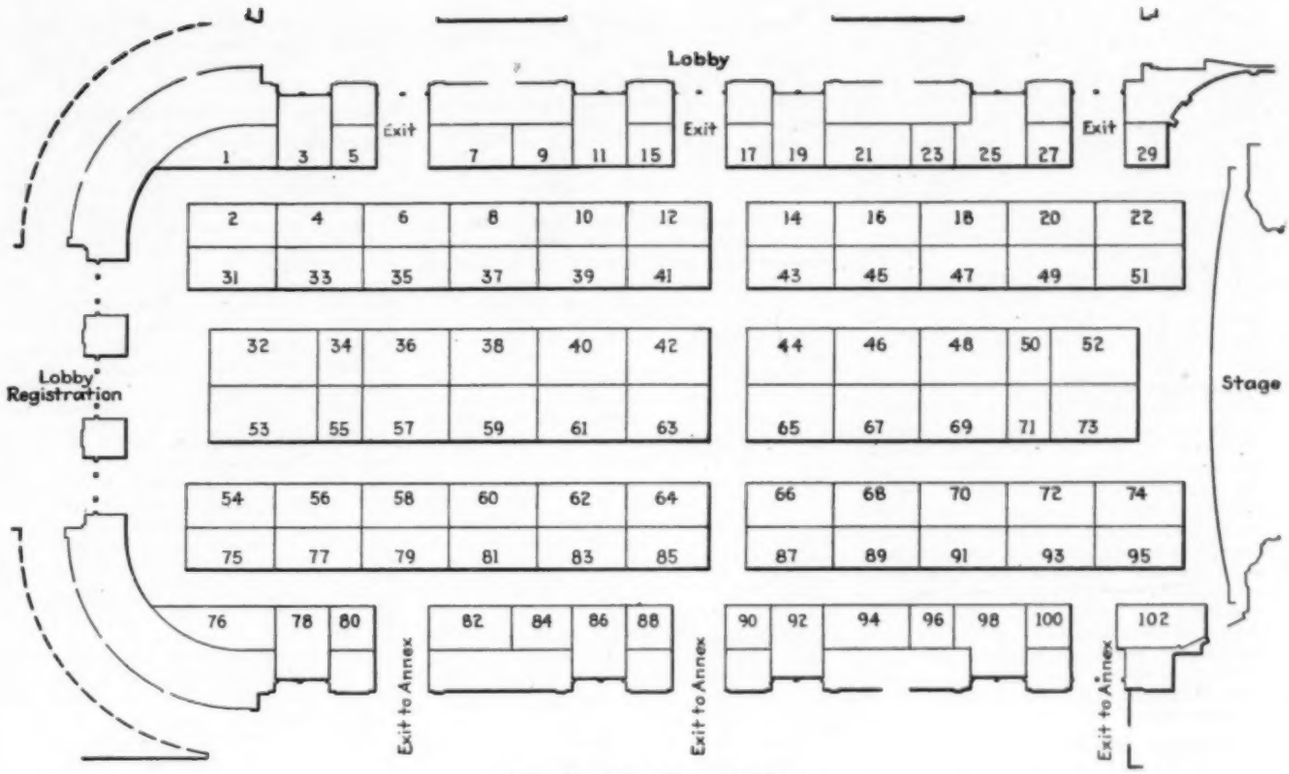
W. H. Dowd, exhibit mgr.; W. C. Swift, service engr.; T. S. Foote; H. M. Paxon; G. E. Newton; C. G. Goodman.

American Car and Foundry Co. 318. A No. 3 three-electrode heater for heating rivets; No. 3 one-electrode two-path heater for heating material for forging or upsetting.

F. C. Cheston; John S. Helt; Harold C. Cheston.

American Electric Furnace Co. 402 and 439. Model HB-1, 8x16-inch high speed furnace and B-2, 12x24-inch box furnace. Models of P-3, 12-inch pot fur-

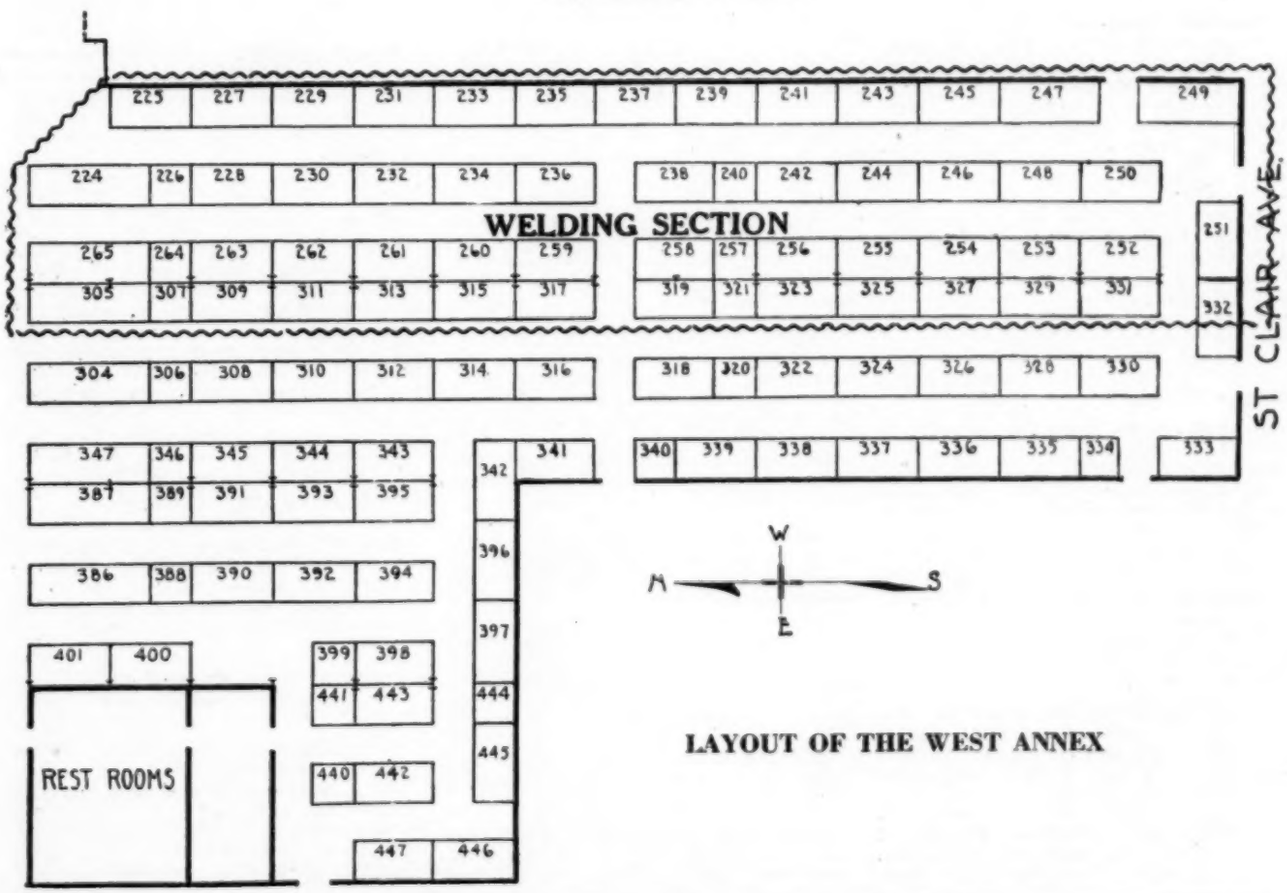




LAYOUT OF THE ARENA

CLEVELAND PUBLIC AUDITORIUM

September 9 to 13



LAYOUT OF THE WEST ANNEX

nace; P-7, 16-inch pot furnace; 18-inch tilting pot furnace; and nitriding furnace.

K. A. Juthe, pres.; S. N. Juthe, v. p.; A. J. Hanson, chief engr.; John C. Juthe, sales mgr.; A. B. Beach, E. E. Bolds, A. A. Anderson; A. D. Heath; L. A. McCalla; L. A. Smith; W. P. Barba; W. T. Haggas.

American Gas Assn. Gas Section. A combined exhibit of the leading manufacturers of industrial gas furnaces and accessory equipment.

E. D. Milener, industrial research rep. and C. W. Beghorn, sec. industrial gas section, of the American Gas Association; A. M. Apmann, Karl Emmerling, J. C. Shanks.

American Gas Furnace Co. Gas Section. Continuous rotary retort heating machine; mesh wire conveyor heating machine; reciprocating-hearth heating machine; heating machine for tempering, temper coloring and gun metal finishing; melter for gold and silver; rotary brass melter; (1) high-speed oven furnace; (2) high-speed oven furnace; large oven furnace for heat treating; rotary retort carburizer; vertical retort gas carburizer.

P. C. Osterman, v. p.; Elmer C. Cook, adv. mgr.; Theodore Farwick, Sr.; John Mehrman, spec. rep.; William H. Kelsey; William J. Barenscheer; O. T. Muehlemeyer.

American Machinist. 322A.

K. H. Condit, ed.; G. S. Brady, mng. ed.; Herbert Chase, asst. ed.; W. E. Kennedy, mgr.; W. H. Shipman; W. S. McFaddin.

American Metal Market. 382.

Rudolph A. Langer, adv. mgr.; Samuel Glassford, cir. mgr.

American Steel and Wire Co. 265. Premier tested welding wire and rods; cold-rolled strip steel; springs; screw stock; and various manufacturing wires.

F. Connell, G. S. Rose, A. G. Bussman, W. E. Mackley, E. S. Humphrys, C. J. McGregor, R. C. Fisher, W. H. Cordes, E. E. Louis, A. T. Merriman; P. G. Gilroy.

Ampco Twist Drill Co. 312. Two Melling Mill-Drill-Matics in operation; drill display board of small tools; new mandrel.

O. Monrad, pres.; E. Loy, secy. and gen. mgr.; E. Leypoldt, sales rep.; R. Rice, sales mgr.; D. O'Brien, service and sales engr.; Fred E. Kelley, service engr.; F. J. Sikorovsky, factory mgr.; George Melling.

Anchor Drawn Steel Co. 10, 12, 39 and 41. Gold Anchor drill rod; Blue Anchor carbon-steel drill rod; Red Anchor carbon steel drill rod; and special cold drawn shapes of high-speed, stainless, carbon and alloy tool steels.

R. C. McKenna, pres.; Floyd Rose, v. p.; George Morrison, spec. sales rep.

Andresen and Associates, Inc., F. C. 392. Publication "Fuels and Furnaces."

F. C. Andresen, pres.; I. Stanley Wishoski, mng. ed.; W. N. Robinson, eng. ed.

Armstrong-Blum Manufacturing Co. 383. Marvel metal band saw; Marvel automatic high speed saw; Marvel hack sawing machines; Marvel high-speed edge hack saw blades.

Harry J. Blum, secy.; Stanley A. Woleben; Jos. C. Fletcher; Walter S. Ryan, Allan M. Andrews; Harry A. Welch; John E. Van Doren, sales dept.

Armstrong Brothers Tool Co. 381. Lathe, planer and shaper tools; drop forged lathe dogs; clamps; ratchet drills; drilling posts; drop forged wrenches; stocks and dies; pipe vises; pipe cutters; pipe wrenches and machine shop specialties.

Paul L. Armstrong; A. Arbogast; George Nufer; W. Welter.

Armstrong Cork and Insulation Co. 98. Armstrong's corkboard insulation; Armstrong's and Nonpareil insulating brick; Armstrong's cork machinery insulation for sound deadening and vibration absorption under machines.

H. B. Gates.

Automatic Nut-Thread Corp. 304. No. 3 Threadnut automatic nut tapping machine; No. 2 Threadnut automatic nut tapping machine with cabinet base; and No. 1 Threadnut hand operated tapping machine, using bent shank tap and continuous tapping.

Eric M. de Sherbinin, pres.; Robert B. Webster, secy. treas.; Christian S. Sorensen, gen. mgr.; Fred D. Creasop, sales engr.; Victor E. Pearson; Joseph T. Ramella.

Automatic Temperature Control Co. 351. Two balancing three-position controllers with anticipating features; one three-position single motor controller; two-position single motor controller; three-position slow motion controller operating oil valves; proportional hand control operating oil and air valves; electric heater controller and a time lag relay.

G. S. Frazee; Ivan Johanson; R. A. Smart; J. D. Andrews, sales mgr.

Automotive Industries. 340.

Hollister Moore, assistant research engr.

—B—

Barnes Co., Inc., W. O. 406. Barnes red arrow high speed steel hack saws, cutting different metals; 3 display boards.

W. O. Barnes, pres.; J. H. Flavell, sec. treas.; F. M. Shaw, eastern sales mgr.; Roy Schindley; A. G. Young; J. M. Munro; C. B. Cecil, western sales mgr.; L. Robertson.

Bastian Blessing Co. 239. Oxyacetylene welding and cutting torches and regulators; oxygen and acetylene manifolds; acetylene generator; high pressure forged fittings; drum valves and accessories.

E. L. Mills, sales mgr.; E. N. Stevens, asst. sales mgr.; Earl M. Evleth, asst. engr.

Bausch and Lomb Optical Co. 7 and 9. Wide field binocular microscope suitable for viewing opaque specimen; magnifiers and readers; microtomes; colorimeters and other optical and measuring instruments; toolmaker's microscope; photomicrographic and projection apparatus; metallographic equipment.

I. L. Nixon; M. H. Stevens; H. L. Shippy; A. R. Farmer.

Bell and Gossett Co. 344 and 345. (See Case Hardening Service Company listing.)

Bellis Heat Treating Co. 352. Lavite and Lavite furnaces; electric furnaces; tempering Lavite; carbon Lavite; high speed Lavite, for temperatures 2000 to 2500 degrees Fahr.

A. E. Bellis, pres.; C. E. Wister; J. W. Black, engr.

Bellevue Industrial Furnace Co. 393.

Bethlehem Steel Co. 44, 46, 65 and 67. Airplane steels; forgings; test specimens pertinent to airplane engine building; tool steels; Mayari iron; Silvery Mayari; sheets and structural sections.

T. F. Fitzgibbons; F. H. Baldwin; J. H. Bateman; E. A. Buxton; G. P. Witteman; H. R. Weeman; D. C. Roscoe; H. W. Hibshman; W. E. Titus; R. S. Tucker; H. E. Graffin; G. Cushman; J. W. Codding; F. E. Fisher; R. MacDonald; W. B. Pritchard; W. R. Shimer; J. H. Stoll; A. P. Spooner; P. E. McKinney; J. F. Gaffney.

Bliss and Laughlin, Inc. 72. Cold-drawn steel, turned and polished shafting, turned and ground shafting and special finished steel; also parts made from the foregoing product.

Walter R. Howell, v. p. and gen. mgr.; W. P. Mitchell, gen. sales mgr.; C. L. Huff, George Spaulding, and C. H. Beach, sales dept.; T. D. Taylor, metallurgist.

Botfield Refractories Co. 210. Adamant fire brick cement; Adachrome fines; Adachrome aggregate; Adamant gun; and Adapatch.

A. H. Engstron, sales mgr.; W. B. Smith.

Bourne-Fuller Co. 25 and 27. Specimens of steel sections rolled in alloy and carbon steels, bolts, nuts, and rivets—standard and special for aircraft, automotive, railroad and other industries.

H. H. Pleasance; C. F. Newpher; N. C. Bolton; R. C. Klemm; H. D. Burket; R. D. Titus.

Bristol Co. 386. Bristol's pyrometer controller, indicating pyrometer, recording pyrometers; new line of automatic temperature controllers; special pyrometer controller; safety set screws and belt lacing

H. L. Griggs, gen. sales mgr.; R. M. Walker, Pittsburgh; H. W. Moss, L. G. Bean; E. L. Stillson; W. F. Emery.

Brown Instrument Co. 272. Pyrometers, indicating, recording, controlling, signalling; flow meters, indicating and recording; thermometers, recording and controlling; meters, indicating and recording; pressure gauges, recording and controlling; automatic control valves; and thermocouples and protecting tubes.

R. P. Brown, pres.; C. H. Kerr, v. p. and gen. mgr.; G. W. Keller, v. p. and gen. sales mgr.; J. P. Goheen, sec.; G. W. W. Cornman, treas.; O. B. Wilson; G. L. Clapper; J. L. Whitten; L. C. Wilson; H. G. Hoffman.

Brown Lynch Scott Co. 388. New style carburizing compound cleaner and grader.

J. A. Scott, sec. and gen. mgr.; W. B. Lynch, and S. W. Perry.

—C—

Calorizing Co. 324. Calite alloys; Calorized steel parts.

B. J. Sayles, pres. and gen. mgr.; D. T. Downes, chf. engr.; H. Schultz, chf. metallurgist; N. E. Ward, sales engr.; R. S. Brown; N. A. Milmine.

Campbell, Inc., Andrew C. 403.

Carboloy Co. 255 and 325. A Warner & Swasey No. 3A Turret Lathe equipped throughout with Carboloy cutting tools and operated at high production speeds on various steels, irons, bronzes, and other materials; Carboloy tools of various shapes and styles.

P. R. Mallory, pres.; E. H. Wilkinson, v. p.; A. R. Howell, sales mgr.; G. V. Rockey, adv. mgr.; G. N. Sieger and Zay Jeffries, technicians; A. A. Merry; W. G. Robbins; W. W. Fullager; W. J. Lindner and staff; P. Petroff; W. H. Martin; W. S. Huson.

Carborundum Co., refractory division. 347 and 387. Standard shapes of refractory materials (Carbofrax and Aloxite) including brick, tile and special shapes; Infrax insulating brick and high temperature refractory cements; silicon carbide grain and Carborundum firesand; Globar-equipped electric furnace constructed to show the relative thermal conductivity of various refractory and insulating materials.

W. M. Smith, sales mgr. furnace dept.; R. A. Beverly; S. A. Fenno; J. A. King; R. A. Barr; W. C. Thiess.

Carborundum Co., abrasive division. 347, 387, 346 and 389. Carborundum and Aloxite wheels in Redmanol and rubber bonds; Globar Division—Globar furnace and Globar heating elements and terminals.

S. F. Courter, genl. sales mgr.; G. W. Chormann, sales engr.; B. H. Work; E. C. Christensen; W. U. Parrott; H. W. Collinson; J. C. Rice.

Carpenter Steel Co. 81. Carpenter Stainless Steel No. 5—Articles made of the five grades of Carpenter stainless steels.

F. A. Bigelow, pres.; J. H. Parker, v. p.; R. V. Mann and F. R. Palmer, assts. to president; B. H. DeLong, metallurgist; G. V. Luerssen and P. B. Greenawald, metallurgical dept.; G. H. Edmonds, and W. M. Loos; C. A. Heil; R. L. Williams; K. L. Crickman; V. W. Gardner; H. G. Roodhuyzen; J. S. Bailey; C. H. Breed; E. von Hambach.

Case Hardening Service Co. 344 and 345. Boknite, carburizing compound; Caseite, cyanide, hardening compound; Cyanide, all grades; Drawite, drawing salts; Bathite, hardening salts; Ni-Cro-Al, alloy pots and boxes; Cleancoat, lead pot covering; Non-Case, anti-carburizing paint; pressed steel pots; B and G oil coolers; Hevi-Duty electric furnaces; pot furnace; box furnace; and Wild-Barfield magnetic control furnaces.

W. C. Bell, pres.; E. J. Gossett, v. p.; J. S. Ayling, sales mgr.; and B. C. Cleveland.

Central Alloy Steel Corp. 14, 16, 43 and 45. Agathon Alloy steels; Toncan copper-molybdenum iron; Enduro Nirosta steel; and Agathon Nitralloy.

B. F. Fairless, pres.; J. M. Schlendorf, v. p.; W. M. Garrigues, gen. sales mgr.; M. J. R. Morris, asst. metallurgical engr.; F. L. Gibbons; A. Schaeffer; D. B. Carson.

Char Products Co. 377. Carburizing compounds and carbon products.

C. Q. Swenson, spec. rep.; C. B. Edwards, chem. engr. and metallurgist; and William Higburg, sales mgr.

Chemical Catalog Co. 367.

Chemical Rubber Co. 283. Laboratory equipment.

A. Friedman, pres.; E. Hartle, pur. agt.; and I. W. Brandel, sales manager.

Chicago Steel and Wire Co. 315 and 317.

Chicago Steel Foundry Co. 285 and 287. Chrome-nickel alloy castings for use at high temperatures; boxes; pots; and furnace parts; sheet alloy fabricated parts; special high-strength chrome-nickel castings.

David Evans, pres.; C. M. Evans, asst. to pres.; Herman Georgen, sales mgr.; J. W. Frank, metallurgist; Wm. J. Chapin, engr.; Gordon McMillan, chemist.

Chrobaltic Tool Co. 204. Heat and acid-resisting castings, including Fire Armor and Zorite alloy; carburizing pots and boxes; pusher grids and trays, rails, retorts and miscellaneous equipment for all manner of metallurgical operations.

W. B. Sullivan, v. p. and gen. mgr.; L. H. Whiteside; C. M. Conner; J. F. Sweeney; A. A. Cash; O. G. Voss; T. A. Meyer; Charles Peterson; H. Klouman; E. Whiteside.

Clark Tructractor Co. 102. Clark 5-ton Truclift, gas-powered industrial lift truck; Clarktor Tructractor, 4-wheeled, gas-powered factory tractor; Clarkat Tructractor, 3-wheeled, small tractor; Whale auto end dump Tructractor.

C. E. Staninger; Everett M. Sharp; R. J. Burrows, pres.; C. I. Ucker; and G. A. Smith, spec. rep.

Cleveland Twist Drill Co. 408, 409, 425 and 427. Two high-speed drill presses demonstrating Cle-forge high-speed drills; display of tools including high-speed drills and reamers tipped with tungsten carbide.

W. E. Caldwell; J. B. Dillard; H. P. Jenson; H. G. Smith; W. C. Weidig; G. Burkhardt; Alfred Jacquin; T. F. Mummery; H. E. Bergquist; Thomas Thomas; E. P. Horan; I. P. Farnum; R. D. Boltey; D. D. Burdett; C. F. Petzinger; T. Skove.

Climax Molybdenum Co. 4. Molybdenum in forms desired by the iron, steel, chemical and dye industries.

B. F. Phillipson, pres.; J. B. Thorpe, asst. to pres.; W. P. Woodside, dist. mgr.; J. Kent Smith, consulting metallurgist; H. P. Furlong; R. L. Rolf; George O. Loeffler; Alan Kissock.

Clipper Belt Lacer Co. 80. Clipper belt lacers, all models, Clipper belt cutters; Clipper belt hooks.

Earl H. Forsyth, fact. rep.

Coats Machine Tool Co. 29. Krupp Mikrotast Gages for internal and external gaging; light contact Krupp Mikrotast for gaging very fine wire; Krupp Mikrotast grinding gages. Elasticometer spring testing machines for tension and compression tests; Prestometer micrometer fluid gage; dividing machine vises; hand tachometers and speed recording indicators; Skailnot, scale preventative.

Charles E. Coats, treas.

Colonial Steel Co. 10, 12, 39 and 41. Ohio, a high-carbon high-chromium air hardening die steel; Colonial No. 7, carbon-vanadium crucible-made tool steel; Red Star carbon tool steel; stainless irons and steels; high-speed, alloy and carbon-tool steel sheets; high-speed, alloy and carbon tool-steel rings, disks and special forgings; copper-clad, ground rods and line material; hot-rolled special shapes; plow steel, soft center; jail bar and safe steel; mining drill steel, solid and hollow; special die blocks.

R. C. McKenna, pres.; Floyd Rose, v. p.; Lawrence Wood, sales mgr.; J. P. Gill, and N. B. Hoffman, metallurgists; H. M. Bray, asst. sales mgr.; George Morrison, spec. sales rep.; F. L. Stevenson, mgr.; R. W. Harris; Charles Schnibble, rep.

Colt's Patent Fire Arms Manufacturing Co. 437. Two different types of Colt Autosan, one with two-tank conveyor; Colt-Noark service boxes and fuses; Nublade switch.

George Webb, mech. supt.; H. S. Seiferman; C. M. Jackson; G. E. MacMannus and F. R. Murphy, sales.

Columbia Tool Steel Co. 62. Alloys, tool steel, ingots, etc.

Arthur T. Clarage, pres.; G. C. Beebe; W. G. Sonderman, E. D. Roberts, and E. W. Luecht, salesmen.

Crucible Steel Co. 38, 40, 42 and 63. Corrosion-resisting articles, indicating the possibilities of this type of material for various purposes.

B. F. Hufnagel, pres.; J. A. Mathews, A. T. Galbraith and J. M. McComb, v. ps.; H. L. Gellinger, auditor; R. Michener, gen. sales agt.; R. E. Christie, asst. gen. sales agt.; J. P. Jayme; E. P. Gaffney; R. H. Heatley; F. E. Phelps; R. W. Crane; M. S. Dravo; R. C. Webster; J. T. Carroll.

—D—

Dardelet Threadlock Corp. 276. Vibrating machine; bolt threader; nut tapper; test specimens; samples of taps and dies; exhibition of various uses of the Dardelet thread; samples of nuts and bolts.

A. Morris Thomson, v. p.; Charles J. Gass, asst. sec.; William E. Hoke, cons. engr.; and Norman C. McLoud.

Darwin and Milner, Inc. 66 and 87. Tool steels; cast dies, etc., made from Cobaltcrom steel; magnets of cobalt magnet steel; other special steels; hack-saw blades.

Victor F. J. Tlach; John C. Koch; Harry L. Harrison; C. F. Lear; Max Opp, New York City; Herman O. Baberadt; H. J. Burnett; C. A. Bowman; H. R. Bowman, Jr.

Dearborn Chemical Co. 92. No-Ox-Id rust preventive; Dearborn cleaners; Dearborn feed water treatment; and hot water system treatment.

E. M. Converse; C. A. Remsen; J. A. Crenner; C. I. Loudenback; E. H. Ruhlman.

De Sanno and Son, A. P. 376. Radiac cut-off machines using an abrasive wheel.

A. P. De Sanno, Sr.; Alphonso De Burnay; Benjamin G. Hardy; L. C. Buckingham.

DeWalt Products Corp. 320. DeWalt portable electric woodworker for maintenance and general construction; circular saw method of cutting seamless and welded steel tubing and formed metal products; jointer.

Paul Gardner, pres.; Robert H. Mulch, gen. sales mgr.; L. J. McLaughlin, dist. sales mgr.; and J. C. Mann.

Donner Steel Co. 412. Cold-drawn bars and die-rolled parts.

W. F. Vosmer, v. p.; A. G. Greenamyer, gen. supt.; C. A. Cherry, asst. to v. p.; D. G. Baxter, asst. genl. supt.; R. E. Sherlock and W. C. Peterson, metallurgical engrs.; L. C. Miller; F. H. Lammert; P. M. Guba; H. C. Richardson; and E. D. Pumphrey.

Driver-Harris Co. 64 and 65. Nichrome castings, retorts, carburizing boxes, pots, pyrometer tubes, furnace parts and other castings for heat-resisting purposes; Nichrome B for addition to cast iron; Nichrome sheet carburizing containers; samples of intricate castings made of Nichrome; Nichrome wire for use as elements in industrial furnaces and other heat-resisting applications.

F. L. Driver, Jr., pres.; S. M. Tracy, treas.; Harry D. McKinney, gen. sales mgr.; G. A. Lennox, asst. sales mgr.; W. E. Blythe; L. H. Waldrip; J. C. Bilek; J. C. Henderson; and J. B. Shelby, engr.

Duraloy Co. 208. Recuperator on rod heating furnace; typical Duraloy-Sklovsky units operating with gas; model of Kathner normalizing furnace and Conklin sheet piler; section of typical sheath-type shaft; Y-valves; miscellaneous pipe fittings; cast impeller; hearth plate; rolling mill guides.

C. P. Mills, chf. engr.; E. S. Lawrence, metallurgist; and H. Hobbs.

Duriron Co. 359. No. 80 Duriron centrifugal pump; Duriron valves; Durimet welded pickling tank and Durimet material in sheets and bars.

E. B. Thacker; W. B. Earnshaw; M. W. Smith; R. Rourke; and E. D. Brauns.

—E—

Eastman Kodak Co. 5. X-ray negatives and photographs of castings showing internal flaws detected by the use of X-rays.

E. E. Smith.

Eclipse Fuel Engineering Co., Gas Section. No. 245 oven furnace automatic temperature control; injectors and burners; gas forge; gas high-speed steel furnace; automatic shop room furnace.

O. M. Olsen, sales mgr.; Kurt A. Scharban, wks. mgr.; D. A. Campbell, O. N. Sellers, sales engrs.; E. A. Stoner, service engr.

Electric Steel Founders' Research Group, Chicago. 89, 91, 93. Representative small and medium sized steel castings of carbon or common steels, and alloy or special steels, made in electric furnaces; physical test specimens, physical test report data.

R. A. Bull, dir.; C. N. Ring, asst. dir.

Electro Alloys Co. 348 and 385. Thermalloy castings such as used in electric furnace construction and heat treating department equipment.

W. J. Hansen; H. P. Miller; A. M. Miller, Jr.; J. W. Henry, metallurgist; J. B. Thomas, treas.; A. L. Garford, pres.; W. C. Whyte, v. p.

Electro Refractories Corp. 15. Silicon carbide brick, in various shapes; high-temperature cement; and Mag-NO-Spall brick; Tercod crucibles; Buffalo patch cement.

L. U. Milward, pres.; C. A. Asher, v. p.; G. S. Diamond, wks. mgr.; C. L. Miller, supt.; C. F. Leitten and C. B. Davis, Jr., ceramists; T. W. Campbell; D. B. Milward.

Elkon, Inc., Division of P. R. Mallory Co. 259 and 260. Welded Ford A chassis on which are 1339 welds; Elkonite tip for the Brewster etchograph machine.

A. O. Brauen, gen. sales mgr.; E. W. Brewer; L. F. Crease; C. R. Frede; J. F. Jenks; E. O. Oberdick, sales mgr.; G. V. Rocky, adv. mgr.; G. N. Sieger, v. p.; J. A. Toleik; R. R. Tompkins; J. A. Weiger.

Ellwood Ivins' Steel Tube Works. 410. Seamless steel tubing; seamless aluminum tubing; seamless Duralumin tubing; and seamless alloy tubing.

Horace S. Kircher, v. p.; Stanley Jeffries, metallurgist; Henry W. Avery.

Endicott Forging and Manufacturing Co. 90. Steel drop forgings used in airplane, automobile and machinery fabrication.

S. J. Marshall, pres.; T. B. Kelday, supt.; George B. Reed, sales mgr.

Enduro Nirosta Committee. 11.

—F—

Falls Electric Furnace Corp. 341. General heat treating furnaces of box type, large and small; sample sections of Falls full formed radiating sheet units.

H. J. McCauley, pres.; J. R. Eves, v. p.; and T. J. Llewellyn.

Federal Machine & Welder Co. 226 and 228. No. 1 portable butt welder; semi-automatic type 2-A butt welder; automatic type No. 60 butt welder; automatic Junior spot welder; 612-B heavy duty full automatic spot or projection welder.

H. L. McCreery, dist. mgr.; J. R. Kilpatrick, sales mgr.

Ferner Co. 374.

Ferry Cap and Set Screw Co. 211. Hardened and ground spring bolts; alloy-steel parts used in automobile engines; special automatic screw machine parts; standard cap and set screws; and Ferry patent acorn nuts.

H. D. North, v. p.; H. B. Pulsifer, metallurgist; E. W. Ferry, secy.; E. G. Greene, supt.; H. A. Keith; William Murphy.

Finkl and Sons Co. 77. Photographs of plant equipment and products.

E. H. Graham, dist. sales mgr.; T. P. Wallace, dist. sales mgr.; J. M. Curley, dist. sales mgr.; W. H. Rieger, spec. rep.; J. C. Vance, asst. sales mgr.; C. E. Finkl, gen. mgr.; Fred Finkl, sec.; Frank Finkl, gen. supt.; William Finkl and M. R. Chase, metallurgists.

Firth-Sterling Steel Co. 69 and 71. Special lathe designed for operating at exceptionally high speeds for demonstrating with Dimondite.

L. Gerald Firth, gen. mgr.; D. G. Clark, dir. of sales; Robert S. Stevick, wks. mgr.; G. J. Comstock, dir. of research; O. K. Parmiter, met. engr.; A. S. Martin, mgr. eng. dept.; C. G. Thoma, adv. mgr.; Dist. mgrs.: A. E. Barker, O. T. Smith, H. I. Moore, E. T. Jackman, G. A. Jacobs, W. C. Royce, W. J. MacFarland and J. V. Little. Also R. F. Kimber; F. N. Mead; I. Olsen; Harry Jarvis; Fred Jarvis; G. R. Bunting; J. Johnson; and W. A. Ruppel.

Flannery Manufacturing Co. 366. Niclad pots for use in the heat treating annealing and cyaniding of steels; graduating and snap action thermostatic gas valves for water temperature control.

J. Rogers Flannery, pres.; E. G. Flannery, H. D. Tietz, G. R. Greenslade, and John J. Kenney.

Ford Co. J. B. 76. Wyandotte metal cleaning compounds.

B. N. Goodell, W. M. Cole, George J. Lawrence, S. H. Renton, C. S. Tomkins, L. C. Warden and C. R. Beaubien.

Fort Pitt Steel Castings Co. 89 and 91. Electric steel castings.

Fusion Welding Corp. 315 and 317. Equipment and supplies for fusion welding and cutting, including Fuzon arc welders and the Carbo-Flux process of welding.

R. F. Beazell, engr.; J. B. Green, pres.; L. F. Collins, sales mgr.; E. J. Shuler, sales engr.; R. W. Holt, research engr.; J. W. Wolcott; F. O. Weber; and Jack McLean.

—G—

Gas Products Co. 239. Oxygen and acetylene gas supplies and welding supplies.

S. M. Wells, mgr.

Gathmann Engineering Co. 1.

Gehnrich Oven Co., Gas Section.

General Alloys Co. 32 and 53.

General Electric Co. 256, 257, 258, and 319, 321, 323.

Gibb Welding Machines Co. 237. Spot welders; welding presses and Gibseamers.

W. H. Gibb, pres.; C. E. Shearer, adv. mgr.; W. O. Little.

Globar Corp. 10 KW high-temperature electric heating elements in operation.

A. H. Heyroth, gen. mgr.; K. E. Rogers, sales mgr.; B. A. Bovee, chf. engr.; W. S. Evans and N. H. Berry, engrs.

—H—

Halcomb Steel Co. 59 and 61. Aircraft parts; tool, alloy, non-corrosive, and special steels and alloys.

H. A. Pardee; H. J. Stagg; J. T. Leyden; S. C. Spalding; J. F. Kirwan; Arthur Schroeder; Howard Hinkley; T. F. Wood; Harold Barlow; Allan Fraser; Leslie Hawkridge; Lee Evans.

Harrington Co. 433. Peerless spur geared hoists; Harrington screw, differential and electric hoists.

R. E. Bishop, sec. and sales mgr.; I. E. Bauer; J. A. Slaughter.

Harris Calorific Co. 234. Multi-stage welding regulators; welding torches; gas welding and cutting equipment; high temperature gas apparatus; general accessories for welding and cutting metals.

J. M. Mathews, sec. and gen. sales mgr.; S. A. Oviatt, research engr.; W. J. Krull; Otto Fathauer.

Hayes, Inc., C. I. 390-A. Electric Globar furnace for high-speed steel equipped with attachment for furnace atmosphere control.

C. I. Hayes, chf. engr.; J. E. Hines, sales mgr.; C. G. Paulson, sales engr.

Haynes Stellite Co. 230. Stellite cutting tools; Stelliting with Stellite welding rod; and Haystellite cutting tools.

F. P. Gormely, v. p. and gen. mgr.; F. T. McCurdy, asst. supt.; W. A. Moore; and E. E. Gordon.

Heppenstall Forge and Knife Co. 82. Working model of Gellert lifting tongs; shear knives; section of split ingot; Hardtem die block.

C. W. Heppenstall, pres.; B. B. Weinberg, v. p.; J. A. Succop, research engr.; R. B. Heppenstall, v. p.; George I. Allen; F. C. Moyer, v. p.; George O. Desautels; Carl J. Sauer; A. J. Porter, Jr.; A. L. Wurster; L. A. Daines.

Houghton and Co., E. F. 354, 355 and 371, 373.

—I—

Illinois Steel Co. 58 and 79. Motion picture of basic processes of making steel, and illustrating in detail the operation of the electric furnace and alloy steel department at the South Chicago plant.

W. I. Howland, Jr.; R. Korsan; J. H. McKown; A. R. Williard; R. G. Glass; F. B. Mulvaney; E. Davidson; Fred W. Bendell; C. R. Moffat; James R. Mills; G. A. Price; G. Landrus; J. Hornbrook; W. H. Brainard; C. E. McIntyre; R. C. O'Neill; H. W. Parker; W. S. Saylor; C. T. Siebert.

Index Machinery Corp. 360. Huster filing and sawing machine; Boley multi-spindle drilling and tapping machine.

Joseph F. Geers, pres. and gen. mgr.; James J. Dillon, asst. mgr.; Max A. Knorpp.

International Nickel Co. 94. Material showing the use of nickel and nickel alloys in industrial applications.

T. H. Wickenden, Charles McKnight, H. J. French, N. B. Pilling, F. B. Coyle, J. S. Vanick, C. A. Crawford, R. J. McKay, T. J. Wood, O. B. J. Fraser, J. W. Sands, A. L. Roberts, and D. E. Ackerman; R. L. Suhl, R. A. Wheeler, L. Muller-Thym, E. J. Bothwell; H. C. Armstrong.

Interstate Iron and Steel Co. 52 and 73.

Iron Age Publishing Co. 372. Current issues of *Iron Age* and reprints.

F. J. Frank, pres.; C. S. Baur, gen. adv. mgr.; Emerson Findley, B. L. Herman, Pierce Lewis, C. H. Ober, W. B. Robinson, W. C. Sweetser, D. C. Warren, F. S. Wayne, C. E. LaChaussee, H. E. Leonard, O. Johnson, B. H. Hayes; A. I. Findley, ed.; W. W. Macon, mang. ed.; E. F. Cone, G. L. Lacher, S. G. Koon and E. E. Thum, asso. eds.; R. E. Miller, G. S. Herrick, T. H. Gerkin; F. L. Prentiss; R. A. Fiske; B. Finney; A. H. Dix; R. Derby; J. M. Hazen; O. H. Niendorff.

Iron Trade Review. 308. Publications of the Penton Publishing Co.

E. L. Shaner, ed.; E. F. Ross, E. C. Barringer and J. D. Knox, asso. eds.; H. B. Vieth, A. H. Allen, F. B. Jacobs; C. J. Stark, pres.; J. D. Pease, v. p.; G. O. Hays, bus. mgr.; John Henry; H. N. Pickett; J. F. Ahrens; S. H. Jasper; F. F. Light.

—J—

Jessop and Sons, Inc., William. 23. Matter pertaining to product of company.

F. C. A. H. Lantsberry, pres.; Robert Ross, sec.; C. L. Bailey; Hans Johnson, G. J. MacQuarrie; H. S. Norman; and L. H. Cummings, sales representatives.

Jessop Steel Co. 8. Tool steel bars; finished dies and parts; cold rolled strip steel, razor blade steel; stainless steel articles and parts; finished cutlery; display showing the evolution of finished saws and other items of manufacture.

S. A. Grayson, pres.; R. E. Emery, v. p.; F. T. Youngman, sec. treas.; R. J. Murray, asst. sec.; V. M. Wellman, D. J. Hanna, A. G. Lambert, W. A. Salt, C. M. Cunningham, W. J. Frederick; J. C. Dawson.

Johns-Manville Corp. 395. Insulating materials; asbestos shingles, Transite, industrial flooring, and packings.

Eugene Dowling; G. E. Grimshaw; J. W. Blenmker; R. C. Hemmingson.

Jones and Laughlin Steel Corp. 55 and 57. Hot-rolled and cold-finished steels, including Jalcase steel parts, cold-finished steel sections, light weight channels, Junior beams, steel piling and tubular products.

W. B. Todd, J. D. Allen, C. C. Henning, J. H. Flaherty, W. R. K. Scott, H. W. Graham, E. A. France, J. G. Hutchinson; A. A. Wagner.

—K—

K-G Welding and Cutting Co. 262. Generators, oil burning equipment; welding, gas welding and cutting torches; oxygen and aceylene regulators.

Wm. D. Flannery, E. Brass, H. H. Kress, William Munn, P. Noren, John Evans, A. W. Carr.

Kelley Co., J. W. 68. Carburizing compounds, lead pot carbon, annealing carbon, quenching oil, tempering oil, industrial oil, heat-treating salts, Greene quenching and washing machine.

J. W. Kelley, pres.; J. E. Burns, v. p.; H. B. Northrup, secy.; P. E. Holder, H. M. Webb, P. J. Myall, J. H. Hopp; C. F. Boyd.

Keller Mechanical Engineering Corp. 407 and 429. Full automatic Keller tool room machine with two-templet rigging and attachment for locating and jig boring; Keller cutter and radius grinder; KELLocatER complete with overarm and improved spindle; Kellerflex flexible shaft machines.

S. A. Keller, treas.; A. S. Keller, adv. mgr.; Henry Schreiber, Charles Bitter, P. C. Renno, W. L. MacRae, E. D. Ashley, Arthur Jenner, and Paul Loewenberg.

Kemp Manufacturing Co., C. M., Gas Section.

Kenwothy, Inc., Charles F. 327. Pictures of installations and samples of annealed products.

C. F. Kenworthy, pres.; H. A. Kenworthy, gen. mgr.; R. E. Worthington, sup.; R. N. Griswold.

Keystone Lubricating Co. 3. Keystone pneumalectric lubricating system.

G. W. Hall, Philip King, Vic. Bergugson, R. C. McDaniel; M. C. Schwenk.

—L—

Lakeside Steel Improvement Co. 6. Photomicrographs; heat treated parts, such as motor blocks, connecting rods, pistons, airplane parts, skid chain, bolts and nuts.

C. W. Derhammer, pres.; R. T. Morrow, v. p.; R. L. Rolf, sec. and metallurgical engr.; John Hume, Jr.

Lava Crucible Co. 60. Super-refractories in standard brick, standard tile, special shapes, plastics, cements and graphite crucibles.

Furman South, Jr., pres.; H. E. White, wks. mgr.; D. E. MacLean, asst. sales mgr.; R. P. South; C. H. Knappenberger.

Lavino and Co., E. J. 349 and 350. Chrome ores; "Lavino" chrome, magnesite and silica brick; Kromepatch; Neutragrog, and plastic K-N chrome.

R. E. Griffith, mgr.; A. DeMacedo; J. B. Luckie, R. C. Hanson, W. C. Holzworth, H. W. Pigott; P. S. Haserodt.

Lebanon Steel Foundry. 89 and 91. Electric steel castings.

Leeds and Northrup Co. 353 and 375. Automatic temperature controllers; pyrometers; temperature recorders; temperature indicators; portable precision potentiometers; portable temperature indicators; thermocouples; miniature Hump furnace and Leeds and Northrup potentiometer, the improved Hump method; miniature Homo furnace and Leeds and Northrup potentiometer pyrometer.

H. Brewer, A. F. Moranty, E. G. Estabrook, P. H. Taylor, G. W. Tall, A. E. Tarr, J. E. Korp; T. C. Smith.

Leitz, Inc., E. 74 and 95. Leitz micro-metallograph; Leitz metallurscope; Guthrie-Leitz grinding and polishing machine; Leitz microscopes.

R. Tvestmann, O. Soetbeer, S. Borell.

Lincoln Electric Co. 224. Lincoln "Stable-Arc" welder and welding accessories and supplies. Safety push button; across the line safety starter for motors up to 30 hp.; alternating current motors.

A. F. Davis, v. p.; Maurice Taylor, T. P. Tarbell, B. F. Kessler, O. P. Hanchette, R. B. Tuhey; A. T. Smith.

Linde Air Products Co. 225, 227 and 229. Oxyacetylene welding and cutting apparatus and supplies; welding generators and Carbic flood lights.

H. F. Buckley, T. C. Fetherston, H. H. Griffith, H. H. Dya; De W. Endicott.

Ludlum Steel Co. 22 and 51. Enduro KA2 steel; Nitralloy steel; tool steels; rustless iron and steel; Strauss metal; tungsten carbide cutting material.

H. G. Batcheller, v. p.; F. B. Lounsberry, v. p.; J. E. Polhemus, asst. v. p.; A. F. Dohn, sales mgr.; C. B. Templeton, asst. to pres.; H. A. DeFries, J. T. Norton and Ralph DeVries, metallurgists; A. K. Martin, supt.; C. W. Lindemuth, asst. to pres.; W. H. Vrooman, and C. B. Boyne, asst. sales mgrs.; K. G. Reynolds; W. Westover, adv. mgr.; W. H. White, T. C. Sherman, H. I. Askew, I. C. Gearhardt, H. Hardwicke.

—M—

Maehler Co., Paul. 206.

Mahr Manufacturing Co. 356. Photographs, photostats and prints of continuous furnaces, car-type furnaces and batch-type furnaces.

W. G. Barstow, sales mgr.; O. E. Ertl, chf. engr.; D. H. Ruhnke, A. J. Nordenson, B. G. Harmon, R. G. White, A. E. Stenzel, R. A. Ledebur; A. F. Tenney.

Manhattan Rubber Mfg. Co. 361. Parts ground with Manhattan rubber-bonded wheels.

W. H. Steinberg, asst. mgr.; C. M. Lawton, C. A. Fox, C. E. Forney, R. G. Brinkerhoff; Howard Pyle.

Marburg Brothers, Inc. 203. Thiel precision die filing and sawing machines.

Theodore H. Marburg, pres.; O. P. Brett; Richard Krause, Herbert Zimmerman.

McCann, Harrison Corp. 273 and 289.

Metal and Thermit Corp. 236. Heavy thermit welding samples and metal samples.

Henry D. Kelley, dist. mgr.

Michigan Steel Casting Co. 37. Misco alloys in the form of castings, rolled bars, wire, and sheets; Hump furnace racks; full size section of a steel mill pack heating furnace in operation.

F. J. Stanley, gen. mgr.; E. D. Flintermann, sales mgr.; J. D. Corfield, sales engr.; A. A. Gould.

Michigan Steel Casting Co. 89 and 91. Electric steel castings.

Michiana Products Corp., Chrobaltic Tool Co. Div. 204. Heat-resisting and acid-resisting castings including Fire Armor and Zorite alloy.

W. B. Sullivan, v. p. and gen. mgr.; L. H. Whiteside; C. M. Conner; J. F. Sweeney, A. A. Cash, O. G. Voss, T. A. Meyer, Charles Peterson, H. Klouman; E. Whiteside.

Midvale Co. 54 and 75. Miscellaneous forgings, tool steel products, and alloy steel products.

W. B. Sullivan, v. p. and gen. mgr.; H. L. Frevert, v. p.; Howard Myers, engr.; J. R. Adams, supt.; Francis B. Foley, research engr.; Henry Ziesing, asst. gen. sales mgr.; H. E. Rowe, Walter B. Smyth, Fred W. Sager, Harvey Garrett, Robert M. Bird, Thomas Besom, Herbert Cox, J. H. Glass, L. C. Berkey; Harry Teel.

Milne and Co. A. 284. Milne tool- and die-steels; hollow drill steel; solid drill steel; auger drill steel; special sections; MR Swedish Lancashire iron; Swedelec cold-drawn electrical iron; Nohab anvils; forged tools; Wardlow's file steel; Wardlow's cutlery sheets; Prince ball bearing steel; Reynolds aircraft tubing.

V. A. Greene, gen. sales mgr.; H. R. Adams, Henry Sears Hoyt, J. King Hoyt, Jr., A. G. Reid, B. Brower, Miss K. E. McDonald.

Milwaukee Die Casting Co. 47. Tin, lead, zinc and aluminum-base alloy die castings; die showing how die castings are made.

C. H. Frantz, sales engr.; H. F. Schroeder, v. p.

Morse Twist Drill and Machine Co. 56. High speed and carbon twist drills; reamers; milling cutters; taps and dies.

W. T. Read, v. p. and treas.; F. O. Lincoln, v. p. of sales; R. F. Chase.

—N—

National Electric Light Asso. 448, 449, 450, 451 and 452. Photographs illustrating applications of electric furnaces to steel heat-treating.

J. L. Faden, Robert M. Keeney, R. T. Kaighin, James H. Faulkner, Charles E. Russell, O. Wilhelmy, H. J. Hall, C. P. Yoder, R. W. Heller, D. H. Gerhard; W. E. Benninghoff.

New Jersey Zinc Co. 414. Die-castings of small and intricate design. Also large die-castings, and rolled zinc, chromium plated and nickel plated.

C. R. Maxon, S. E. Maxon, R. M. Curts, R. Davidson, W. J. Keuhn and W. P. Hardenbergh, Jr.

Northwestern Manufacturing Co. 234. Large arc welder; gaesoline-engine-driven arc-welder; also welding parts.

K. L. Hansen, F. A. Wilch and A. H. Friese.

Norton Co. 288 and 290. High speed grinding equipment; American Electric Furnace; Norton abrasive products; and Norton heavy refractories.

Robert Kirkpatrick, H. A. Blackburn, K. H. Bird, A. R. Sandine, R. H. Cannon, A. T. Douglas and H. R. Swanberg.

Nugent Steel Castings Co. 89 and 91. Electric steel castings.

—O—

Ohio Steel Foundry Co. 278. Fahrite heat resisting alloy.

W. J. Gilmore, v. p.; W. J. Hayes, Jesse F. Monfils.

Olsen Testing Machine Co., Tinius. 48. A 100,000-pound capacity Olsen 3-screw rotating-gear nut-type automatic and autographic universal testing machine; combined impact tension and cantilever type (Izod type) of impact tester; Haight alternate stress testing machine, production-type Brinell hardness tester; Herbert pendulum hardness tester and production type "Cloudburst" hardness tester; Olsen hardness tester for rubber compounds; production type ductility testing machine; verifying rings of various capacities; strain gages and measuring instruments; Olsen-Lundgren dynamic balancing machine; automatic weighting static balancing machine.

T. Y. Olsen, R. B. Lewis, Jacob Lundgren, and Bruce L. Lewis.

—P—

Page Steel and Wire Co. 311.

Park Chemical Co. 15. Casehardening compounds; cyaniding compounds; drawing salts; re-heating salts; lead pot covering; carbon preventer; lacquer rubbing compounds; masking compounds; quenching and drawing oils.

Joseph N. Bourg, v. p. and gen. mgr.; J. C. Thompson; F. W. Faery.

Pels & Co., Inc., Henry. 203, 205 and 207. Type FV-55 big billet shear; Type STAQ-16 gate shear; Type Pg. 35 closed-throat press; Type BLUEFGA-22sp. combination punch, plate shear, angle, bar and tee cutter. Type MAE-16 combination punch, plate shear, angle, bar and tee cutter with built-in notcher; Type ME-10 combination punch, plate shear, angle bar and tee cutter with built-in Coper; Type EFG-16 angle, bar and tee cutter.

C. L. Martin, v. p.; T. F. Kane, E. E. Tailfer; J. A. Weigand.

Permutit Co. 370.

Pittsburgh Instrument and Machine Co. 96. Brinell testing machines; Impact testing machine; Sheet metal tester; metallographic grinder; Brinell microscope; depth indicator; proving ring; direct-reading Brinell instrument.

Charles Trueg, member of firm; Walter Kammerer.

Pressed Steel Co. 410-A. Lite-Wate Rezistal carburizing and annealing boxes; welded and seamless formed containers.

J. H. MacVeigh, v. p. and sales mgr.; F. A. Schmidt, wks. mgr.

Production Machine Co. 306. Centerless polishing and finishing machines; combined disk-grinder and polishing machine.

W. S. Howe, pres.; A. H. Behnke, v. p. and sales mgr.; T. A. Welsh, supt.

Prosser and Son, Thomas. 401. Tool grinder; Monarch lathe; Widia tools for various machines.

R. D. Prosser, gen. mgr.; W. E. Guild, sales mgr.; E. R. S. Reeder, J. A. Deakin.

—R—

Ransohoff, Inc., N. 392. Star return tumbling barrel; samples of work done by it.

N. Ransohoff, D. M. Powers.

Reeves Pulley Co. 316. Reeves variable speed transmission.

Carl M. Reeves, v. p.; C. L. Irwin.

Reintjes Co., George P. 279. Interlocking arch tile for forging and heat treating furnaces.

George P. Reintjes.

Republic Flow Meters Co. 275. Republic control pyrometer.

K. B. Roudebush, C. H. Tate, T. E. Bell, C. E. Pritchett, R. C. Ascher; E. Schneider.

Riehle Brothers Testing Machine Co. 100.

Rockwell Co., Stanley P. 404. Rockwell Dilatometer with enclosed panel attached to pit type electric furnace; portable quenching tank agitator.

Stanley P. Rockwell, pres.; William A. Stumpf, sales mgr.

Roebling's Sons Co., John A. 234. Samples of welding wire.

R. R. Newell.

Roessler and Hasslacher Chemical Co. 19 and 21. Chemicals used in casehardening, heat treatment, and heat coloring of steel; and in electroplating of metals.

Walter M. Gager, metallurgist; Charles H. Proctor; Carl Dittmar, sales mgr.; Carl Hamann.

Rotor Air Tool Co. 343. Portable pneumatic drills, grinders, sanders, and buffers.

H. P. Bailey, pres.; K. L. Pohlman, v. p.; W. G. Baily; C. B. Scott.

Ruemelin Manufacturing Co. 326-A. Sanitary sandblast cabinet; exhaust-type fan; midget sandblast gun; operator's sandblast helmet; Junior sandblast generator.

H. A. Flitz, T. C. Tipper.

Ryan, Scully and Co. 348. Automatic control valve for multiple stage control; continuous belt; burner equipment.

F. J. Ryan, pres.; Gordon A. Webb, A. H. Kruger; J. Kniveton.

Ryerson and Son, Inc., Joseph T. 368. Samples of general steel products; cold-rolled steel products; tool and alloy steels; rust- and heat-resisting alloys.

H. B. Ressler, gen. sales mgr.; Fred Doran, G. Van Dyke, A. Y. Sawyer; Charles Kehr.

—S—

Safety Equipment Service. 233. Superdrednaut goggles; respirators; "Safety Service" clothing; sandblast and dust hoods; welding helmets; gas masks; saw guards; linemen's gloves; acid-gloves; machine, emery wheel, punch press, belt, and gear guards; non-explosive cans.

Buell W. Nutt, pres.; Harry F. Lea, Andrew Evers, F. C. Blake, E. C. Lyon.

Selas Co., Gas Section. Selas gas-mixing machines operating various industrial gas appliances; Selas-fired industrial gas furnace, automatically controlled.

Fred Hess, mgr.; E. A. Furkert.

Scherr Co., Inc., George. 200. Carl Zeiss precision measuring machines and instruments; Taylor rotary cutting-off machine; Schuchardt and Schutte thread milling machine.

George Scherr, pres. and mgr.; Fritz Konig, v. p.; George Kaner; George Van Daplank.

Sentry Co. 391. Sentry furnaces with control, also high-speed steel hardening using the Sentry diamond block method.

F. B. Crocker, asst. mgr.; A. A. Haryer.

Shakeproof Lock Washer Co. 357. Standard lock washers and locking terminals.

Herbert M. Towison; J. M. Gribbie.

Shawinigan Products Corp. 239. Carbide and carbide packages.

W. P. Chur.

Shore Instrument and Mfg. Co. 17. Hardness testing instruments; Shore monotron, with new features; rubber testing instruments; optical pyrometers; Localcase and Localhard.

F. G. Kendall, sales mgr.; J. M. Kendall.

Simonds Saw and Steel Co. 342. Metal-cutting circular and band saws; files, hacksaw blades; high-speed, carbon, magnet and special tool steel.

C. R. Pafenbach, George T. Curtis, and Harry P. Baumann.

Sivyer Steel Casting Co. 89 and 91. Electric steel castings.

Smith and Sons, Inc., David H. 438. Smith billet shears; angle bending rolls.

William H. Kay, mgr. sales; Dudley J. Smith, v. p.; Olaf Olsen.

Snap-On Wrench Co. 280.

Southern Manganese Steel Co. 18. Fahralloy high temperature and corrosion-resisting products.

F. A. Fahrenwald, metallurgist; A. W. Daniels, gen. sales mgr.; Russell J. Williams, asst. sales mgr.; D. M. Powers.

Southwark Foundry and Machine Co. 31. Southwark-Emery universal testing machine; McCollum-Peters electric telemeter; Whittemore strain gage; Huggenberger tensometer.

F. G. Tatnall, mgr.; H. A. Weaver, engr.; and H. J. Ruch.

Spencer Turbine Co. 291. Spencer turbo-compressors.

S. E. Phillips, pres.; F. A. Wright, F. E. Warnke; R. A. Brackett.

Stamets, William K. 205, 205-A and 207.

Standard Alloy Co. 33. Standard-alloy lead pots; cyanide pots; normalizing and pack heating furnace disks and spacers; insulated shaft assembly for normalizer; chain grate castings for heat resisting service; furnace trays and shoes and similar parts.

Harvey M. Smith, sales mgr.; Frank F. Jackson, supt.; Emerson M. Williams, sec.; Charles D. Cutting, H. A. Cutting, W. D. Mann, George S. McFarland; A. D. Darragh.

Standard Equipment Co., Inc. 379. Photographs of installations of the Standard patent scouring machine.

Charles A. Dreisbach, pres.; Burton L. Hoskins.

Steel City Testing Laboratory. 102.

Steel Publications, Inc. 286.

M. M. Zeder, sec. and treas.; D. N. Watkins, pres.; R. E. Powell, G. N. Herman, Charles Longenecker; F. B. Yeager.

Stoody Co. 241. Welding rods and welding equipment, including grinders and electrode holders.

Robert L. Ozias, adv. mgr., and C. E. Phillips.

Strong, Carlisle and Hammond Co. 209. Duralumin treating furnace; element, ribbon resistor of low watt density. Leeds and Northrup automatic temperature control.

G. S. Peterson, sales mgr.; Jacob Weintz; A. B. Lindsay.

Stuart and Co., D. A. 78. Parts machined with new type metal-working oils.

C. H. Baker, G. A. Dudley, W. M. Duncan, W. H. Huelster, T. B. Langdon; W. H. Oldacre.

Sullivan Machinery Co.—Gas Section.

Surface Combustion Co.—Gas Section.

—T—

Thompson Grinder Co. 378. Moore fatigue testing machine.

W.G. Balderhofer, mech. engr.; R. R. Baldenhofer.

Timken Steel and Tube Co. 24 and 36. Moving exhibit of use of Timken steel and the services available through this company.

M. T. Lothrop, pres.; A. J. Sanford, v. p.; W. G. Hildorf, chf. metallurgist; R. L. Wilson, metallurgist; Robert Atkinson; Walter Wiewel.

Tomkins-Johnson Co. 369.

Torchweld Equipment Co. 264. Torchweld hand welding and cutting torches; machine welding and cutting torches; decarburizing equipment; lead-burning equipment; acetylene generators; gas pressure regulators and accessories.

W. A. Slack, pres.; R. M. Smith, asst. sales mgr.; H. G. Larisch; C. E. Davis; W. E. Lyons.

Trent Co., Harold E. 341. Electric furnaces and temperature control for heat treating, pit-type, pot-type and oil-quench-type furnaces.

H. E. Trent.

—U—

Una Welding and Bonding Co. 261. Una welders, both ac-dc and dc-dc types with automatic welding head; Welding rods for manual and automatic weldng.

E. R. Alexander, E. W. Kronbach, A. A. Probeck, H. P. Blum, W. J. Bushea, L. S. Burgett, and J. P. Austin.

—V—

Vanadium Alloys Steel Co. 10, 12, 39 and 41. Red Cut high-speed steel; Non-shrinkable die steel; Marvel hot-working die steel; Colhed, a new steel for cold heading; Crocar, a new high-carbon high-chromium steel; fractures and tools of the above steels.

R. C. McKenna, pres.; Floyd Rose, v. p.; L. D. Bowman, wks. mgr.; J. P. Gill, metallurgist; R. B. George, W. R. Mau, W. D. Fisher, T. J. Van de Motter; C. V. Reilly.

Vanadium Corp. of America. 20 and 49. Ferro-vanadium, ferro-chromium, ferro-silicon, and other steel-making alloys; ores; oxides; chemical compounds of vanadium, tungsten, molybdenum, chromium, and other metals; Vanadium steel forgings and castings illustrating applications of vanadium steels for automotive and locomotive parts, machine tools and other purposes.

J. A. Miller, gen. mgr.; H. T. Chandler and N. Petinot, asst. to pres.; C. N. Dawe, C. B. Woodworth, T. N. Bourke, B. D. Saklatwalla, v. p.; Jerome Strauss, research engr.; G. L. Norris, metallurgical engr.; A. W. Demmler.

Van Dorn Electric Tool Co. 35. Portable electric drills; grinders; reamers; tappers; screw drivers; nut setters; stationary grinders; electric socket wrenches; and portable electric hammers; in operation.

F. Schneider, pres.; F. H. Zulauf, v. p. and genl. mgr.; R. W. Proctor, sales mgr.; E. W. Waechter, asst. mgr.; S. S. Waters, L. L. Charnicky, F. R. Du Guay; F. H. Schell.

Victor-Peninsular Division. 274.

Victor X-Ray Corp. 322. X-ray negatives, showing imperfections in materials, such as castings, welding and assemblies.

E. W. Page.

—W—

Walter Treatment Co. of America. 227. Reception and literature.
Harry L. Baer, pres.; George Neilson, v. p.

Weidemann Machine Co. Booth 6. Spring winder for any desired pitch or tension of springs.
O. F. Wiedemann, G. A. Hancock.

Weldit Acetylene Co. 242. Oxy-acetylene welding and cutting equipment and Gasavers.
O. L. Smith, pres.; J. B. Manor; J. Bronson.

Welding Engineer Publishing Co. 245. Magazines and books devoted to the welding processes and their applications in industry.
H. S. Card, ed.; R. K. Randall; R. A. McCarthy.

Westinghouse Electric and Manufacturing Co. 305. Automatic welding outfit including new type head, control and operator's panel. 200-ampere portable motor-driven welding set; 200-ampere portable gas engine driven welding set; 400-ampere portable motor driven welding set; sample welded joints and other welded products.
W. W. Reddie, R. L. Cronemeyer, G. H. Koch, welding engineer; F. M. Bernard, W. G. Pearson, C. W. Babcock; P. H. Grunnagle, adv. dept.

Wheeling Mold and Foundry Co. 400. Model steam hammer.
H. E. Field, pres.; E. A. Balsley, v.p.; R. C. Heaslett, metallurgist; D. Wyman, asst. to pres.; George Chandler.

Wheelock, Lovejoy and Co. Inc. 84, 86 and 88. Moving pictures of loading, cutting, testing, heat treating; of Hy-Ten special steels.
A. Oram Fulton, pres.; Frederick H. Lovejoy, v. p.; George S. Longley, Jr.; Edward C. Bartlett, Stanley W. Parker, C. Robert Jenks, Murray N. Allison, George A. Baron, Henry A. Bischoff, A. Reed Townsend and Floyd J. DeVan.

Whitman and Barnes, Inc. 83. Drills, reamers, milling cutters and end mills.
Fred J. Smith, service engr.; E. T. Oliver.

Wickwire Spencer Steel Co. 238 and 240. Wisscoloy spiral conveyor belt; samples of Wissco oil-tempered valve spring wire; samples of coil springs, formed wire and types of welding wire.
F. W. Hale; Dwight Granger, chf. engr.; Jay R. Worsfold, sales mgr.; E. C. Stout, R. H. Clapp, U. V. Westover, G. W. Nelson, V. C. King, M. G. Werme, E. F. Early, R. R. Tatnall, R. C. Jordan; F. J. Connors.

Williams and Co. Inc. 243. Welding tests of Colortipt welding rods.
E. C. Edmundson, gen. mgr.; W. J. Lyons and N. J. Carbis, welding engineers; J. H. Penske, Jr., K. J. Burkholder, B. F. Prentiss; H. M. Turner.

Willson Products, Inc. 251. Protective glass for welding goggles and shields.
F. H. Klein.

Wilson-Maeulen Co. Inc. 405. Indicating pyrometers; recording pyrometers; automatic temperature controllers; electric resistance thermometers; and Rockwell hardness testers.
John P. Roberts, Harvey Lee, G. B. Duff, engr.; M. A. Schreiner, F. Walter; C. E. Hellenberg.

—Z—

Ziv Steel and Wire Co. 66 and 87.

Supplementary List of Exhibitors

American Engineering Co. 398.

Bellevue Industrial Furnace Co. 393. 25 kw. electric furnace for hardening and carburizing, also preheating of high-speed steel; 40 kw. high-temperature furnace for hardening high-speed steel, equipped with Globar non-metallic heating elements.
Walter E. Hinz, pres.; Louis J. Raymo, sls. mgr.; Arnold Pfau, Jr., eng.

Binghamton Flexible Shaft Co. 365.

Campbell, Inc., Andrew C. 403. Campbell nibbling machines.
H. R. Powell; J. Johnson.

Clark Electric Co., James, Jr. 365.

Chemical Catalog Co., Inc. 367. Sample copies of Metals and Alloys, a monthly paper.
William P. Winsor, dist. mgr., Cleveland; Richard Rimbach, as. ed.; H. W. Gillett, ed. dir.; Francis M. Turner, Jr., pres.

Detroit Alloy Steel Co. 326A. Wood patterns used in manufacturing Dasco alloy tool castings; Dasco alloy tool steel castings as cast; and pressed metal dies made of Dasco alloy tool steel.
High Martin, pres.; H. H. Wyatt, sec. treas.; H. F. Kluender, sls. eng.; W. A. Spindler, chemist.

Egeberg, Birger. 410. Volumetric carbon determination apparatus; optical pyrometer, vest-pocket size; quick-acting laboratory balance.
Birger Egeberg, mgr.

Enduro Nirosta Committee. 11. Applications of Krupp Nirosta steel in fabricated forms.
Representatives from Central Alloy Steel Corp., Ludlum Steel Co., and Babcock and Wilcox Tube Co.

Evans-Wallower Zinc Co. 397.

Ferner Co., R. Y. 374. New model of Swiss jig borer No. 4; new models of micro-indicator tubes and stands for high-precision measurements in inspection work; universal measuring machine.
R. Y. Ferner, prop., Fernand Turrettini, dir. genl., Societe Genevoise; Walter S. Ryan; John Cetrule; Lambert Neff; Charles T. Ameel.

Garlock Packing Co. 339. Line of mechanical packings.
R. W. Perkins, dist. mgr., and B. B. Franklin, sls. rep., Cleveland; C. E. Hermansader.

General Alloys Co. 32 and 53. Line of nickel-chromium heat-treating containers and furnace parts made from Q-Alloys; carburizing boxes; cast, all sheet, combination cast bottom sheet body, combination corrugated sheet sides and cast corners; carburizing tubes; lead, salt and cyanide pots; supporting rings; cyaniding baskets; grid trays; Q-Alloy furnace parts, hearth plates, roller rails, trays, anchors, support members, Hump furnace fixtures, bolts, nuts, retorts, muffles, jigs and fixtures.
H. H. Harris, pres.; W. K. Leach, genl. mgr.; G. C. McCormick, ch. eng.; W. R. Blair, eng.; F. J. Blaney, genl. super.; J. J. Baum, eng.; J. J. Donovan, Chicago, sls. mgr.; W. A. Toohill; A. L. Grinell; J. H. Abbott; R. M. Kirk; Ralph Hare; H. G. Chase; E. R. Dougherty; C. E. Malley; J. C. Van Arman; R. N. Graves.

Irwin Lumber Co. 338.

Kelley-Koett Mfg. Co. 314. X-ray apparatus for fluorscopic and radiographic study of metals.
W. S. Werner, sec. and ch. eng.; Dr. Hahn, ed. dept.; H. C. Steadman.

Kemp Manufacturing Co., C. M. Gas Section. Improved Kemp system for the industrial utilization of natural or artificial gas; burner equipment; Nash motor operated similar to the "block test."
W. M. Ponder, R. S. Van Note, W. S. Bassett and F. H. Andrews, sls. eng.; William Hunt, research eng.; E. B. Dunkak, sls. mgr.

McCann-Harrison Corp. 273 and 289. Continuous conveyor beam furnace.
H. P. McCann, pres.; Robert L. Corbett, sls. mgr.; Edward Busch; Charles L. Stuart.

Page Steel and Wire Co. 311. Testing machine showing De Forest magnetic method of testing of Page Armco welding wire for both gas and electric welding.
W. T. Kyle; J. J. Flaherty; C. A. McCune; W. L. Walsh.

Riehle Bros. Testing Machine Co. 100. Vickers hardness tester; calibrating rings; Brinell machine; mirror extensometer reading to 1/100,000 of an inch.
A. Fuller Riehle, v. p. and supt.

Rustless Iron Corp. of America. 93. Articles made from rustless iron, such as automobile parts—hood hinges, running board moldings, lamp cases.
Dr. M. H. Sommer, dev. eng. and asst. to the pres.; A. L. Grinell.

Square D Co. 332.

Taylor-Winfield Corp. 244. Spot and butt welding equipment and a portable type of spot welding machine.
F. C. Terry; engineers from main plant.

Toledo Scale Co. 328.

Tomkins-Johnson Co. 369. Die-sinking milling cutters; air-operated chucks and cylinders.
R. B. McDonald, sls. mgr.; A. R. Johnson, treas.; H. A. Tomkins, pres.

United Engineering Society. 435.

Regulated Control in

HEAT-TREATING ALUMINUM-ALLOY CASTINGS

Physical test bars are cast from every heat of aluminum alloys at the Fairfield plant of the Aluminum Company of America. A separate room, shown at the right, is used for making the tests. Chemical tests are also made, and at least one casting from each lot is X-rayed. Castings are heat-treated or aged according to the requirements of the alloy.

The heat-treating room shown in the lower view is kept spotlessly clean. All steel-work and the furnaces are painted with aluminum paint. The castings to be heat-treated come in from the inspection room on the monorail conveyors in steel baskets which can be seen in front. Temperature and time controls on the furnaces

are automatic, and the workmen are notified by signals from the control room seen at the right. The baskets are drawn in and out of the furnaces on light trucks by the electric mule shown in front of the furnace. The quenching tank is below the floor. It measures 10x14 ft. by 10 ft. deep and has hinged doors operated by push-button control. After heat-treating, the castings continue around the monorail through another door into the inspection and shipping room. Aging of castings is done in a special tank heated by steam at 75 lb. pressure, and reached by the monorail shown in the center.

The following narrative is a "case" presentation of the topic. It has been written to involve some of the questions that arise in the average shop. For guidance in preparing discussion the questions given at the foot of the page have been arranged

THE · FOREMAN'S

Tempering General-Purpose Tools

"MORNING, Ed," said Al, as the two foremen met at the lunch counter, "What's this I hear about you mixing up with the foreman of the hardening room. You and he on the outs?"

"Not at all; I didn't ride him hard. I simply told him that we hadn't put a decent tool out of his department since it was started."

"Wasn't that pretty strong for an impersonal statement, Ed?"

"Oh, I'll admit that I exaggerated a little, but ever since we retired old Sam Hudson because we thought he wasn't scientific enough to run our new hardening outfit, my chipping costs have been way up.

"Maybe he didn't know more about heat-treating, but he did have more knowledge of what a tool had to stand, and he spent 40 years finding out how to make them stand it. Instead of watching a pyro-what-do-you-call-it, he went out in the shop and watched the tool. If that isn't training, what is it?"

"Well, maybe he did temper chisels better, Ed, but they are a small item to get all het up about, aren't they?"

"Not be a jugful. And besides, it's not just chisels, its riveting sets, round punches, calking tools, and—but let's stick to chisels. I have ten chippers, and they chip everything from brass to nickel steel, and with only one temper of chisel. We get new kinds of metal to cut, but do we get new kinds of chisels?"

"You think that regulated heat-treatment is a failure, then."

"No, but I think that we will know a lot more about it sometime. There is still a lot of personal experience needed besides the pyros and the systems."

"How about lathe tools, Ed? The hardening room does them too."

"Yes, and why do some of them last a week, and some only about a minute? If the right variation strikes the right metal, its a good tool; if they don't connect, we blame the man for grinding it wrong."

"Admitting that your argument is better than usual," joked Al, "what is the answer?"

"That's how the argument started this morning. The hardening foreman said that he had records to show that he was hardening to specifications, and that I was only guessing why they failed. I told him that if the steel was uniform, his pyrometers correct, and his furnace temperature even, we were just wasting money hiring inspectors, and that all he had to do was to check his graphical records. For good measure, I asked him why he used the old-fashioned file method, after all his scientific tests."

"Well, Ed, I wouldn't be surprised if you weren't about half right. I'm a great believer in automatic controls of all kinds, but it always seems a problem just how much you can leave out the personal element."

Do certain tools need more personal care than the average heat-treating department can give? Are automatic controls and specifications sufficient for good results in tool work?

All foremen are urged to discuss these questions vital to their work; of course the

ROUND · TABLE

DISCUSSION OF EARLIER TOPICS

When Do Automatics Pay?

AUTOMATIC machines pay when work is produced in fairly large lots, and when the volume of work going through will keep them running steadily. This type of machine is expensive, and should be bought only after careful consideration. Among the points to be looked into are special tools required that are used on automatics only, cost of labor when only one or two machines are required, and the cost with all charges included.

It was my experience not long ago to see an expensive automatic grinder installed where the lots going through were small. This resulted in the automatic standing idle several days at a time or doing work at higher cost per piece than the old machines. This condition was because of a long set-up time, which is common to most automatic machines. Another point to consider is the time required to obtain form tools and similar equipment. If orders must be started promptly, it then may be found that less complicated machines will give more satisfactory deliveries and add little or nothing to the net cost.

—L. F. SWENSON, *Industrial Engineer, Perkins Machine & Gear Company.*

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Picking Men in Cheerful Surroundings

INTERVIEWING an applicant for a position in an attractive room may make him feel better for the time being, but the arrangement of the room in no way indicates conditions in the shop where he will be required to work. It is a fact that labor turnover is costly, but it requires imagination to believe that the furnishings of a room can be of any assistance to the personnel manager in determining a man's skill or character.

Assuming that the interview takes place in a dark, practically unfurnished office, it is probable that the courtesy, or lack of it, which is shown the applicant, will impress him more than his surroundings. Rather than make a display of lavish decorations, I believe it would be better to take the applicant out into the shop where he would work. Here he will see conditions as he will encounter them every day. I believe, also, that the applicant's fitness for the position can be more accurately determined in the shop. His attitude among the machinery which he is accustomed to handle will indicate more than his answers to a lot of stereotyped questions. —R. H. KASPER, *Master Mechanic, Steel Heddle Manufacturing Company.*

IN THIS age of efficiency the question of employing men should be given its proper share of attention. Setting aside the financial part, there is nothing that causes more irritation to a foreman than to find that a man is not fitted for the job he has been hired for. The only way to guard against this is by having a suitable place set aside where applicants can be interviewed, and a cheerful atmosphere cannot possibly do any harm.

There is no doubt that we are responsive to our surroundings. In the theatre or dance hall most people get as much pleasure from the enviroment as they do from the show or dance. Cheerfulness in the employment office tends to show a man at his best, and this should be the aim of the prospective employer. For anyone who has had a little experience in the employment of men it does not take many minutes to detect the flaws and weak points. Everything, however, can be overdone. Discretion should be used in the matter of easy chairs and pictures. It all depends upon circumstances. In the employment office of a large machine works in New York, the applicant cannot help noticing one or two machine details, such as small gears, pillow blocks, or the like, which are lying on the interviewers' desk, or nearby. The foreman who picks the men says that this has helped him considerably.

—E. MILLAR.

THE impression produced on a visitor, no matter what his business, when ushered into a reception room should be that here he will meet with courtesy, and will be dealing with an organization, the principles of which are thoroughness, sincerity, and efficiency. The influence upon the firm's own officials should naturally be the same, and the atmosphere of the room should make it easier for them to strengthen this favorable impression by their own attitude.

A factory in which the applicant for work is shouted at through a peephole gives the impression that it is one in which "hole and corner" methods are the order of the day. The impression produced on the applicant if invited into the gateman's room to wait until someone from the office comes to look him over is that the firm is very poor, or that it regards its employees as so many check numbers. An interviewing room, which, on the other hand, savors too much of a club lounge will overawe the applicant for work or will give him the impression that he has entered some charitable institution.

The keynote of the furnishing of an interviewing room should be that of simplicity and good taste rather than of comfort. —H. J. BURNHAM, *Birmingham, England.*

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Keeping Posted On New Tools

WILLIAMS was general superintendent because he did the things that Ed characterizes as "fairy stuff." I am in agreement with both Al and Williams, because I prefer to be a first-class mechanic and am proud of my profession. Whether or not the acquisition of knowledge brings its proportionate pay, it is contended that such knowledge is an asset that has no financial equivalent. No matter how much we kr.ow, we cannot all be foremen or superintendents, but it is em-

discussion is not limited to foremen. Letters accepted and published will be paid for

phatically contended that every man who professes to be a mechanic, possesses an invaluable asset if he hab tually acquires and conserves knowledge.

As a life time shop foreman, I should at any time have been ashamed to confess that my superior knew more about tools that were available or on the market, than myself. In my opinion, the shop foreman should be equal to acting in an advisory capacity to his superior with respect to tools for his own shop, and it is obvious that to fulfill that duty he must keep himself well posted.

—J. T. TOWLSON, *London, England.*

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The Man Who Shows Interest

IN THESE days of specialization and single purpose machines, a man who wants to get ahead must do so by seeing what the other fellow does. Therefore, a man who spends his leisure time in "nosing" around is adding to his knowledge and to his value to the company. It is, of course, understood that he will not tamper with, nor molest, the machines or products in any way, or become a nuisance. Aside from this he should be encouraged.

—FRED KLINGSTEIN, *Tool Engineer, Walter Kidde & Company, Inc.*

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Stirring Up the Foreman on Accidents

ACCIDENTS are costly in many ways. The shop routine is upset, production is lowered, morale is weakened, and the victim suffers. While all accidents are lamentable affairs, the vast majority of them are unnecessary and preventable. They almost always happen as a result of carelessness or negligence.

The foreman should endeavor to prevent accidents. He should be on the alert constantly for the safety of his men. Bad conditions in the machinery or building should be corrected as soon as found so that they do not become dangerous. The foreman should personally see that all guards and safety devices are in place and in use all of the time. The men should be cautioned continually and taught how to perform their labors in the right way. Thus, they will be trained in the habit of safety.

—L. O. BROWN, *Toolroom Foreman, Holcomb and Hoke Manufacturing Company.*

Radio in the Shop

WHILE radio is of great value as a means of education and entertainment, its use in the average machine shop would be more of a liability than an asset. There is no doubt whatever in my mind as to the devastating effect the broadcasting of the world's series at one end of the shop would have on an enthusiastic baseball fan cutting threads on a lathe at the other end. Of course, where it would be used only for noon-hour entertainment, it would be very welcome.

It would be interesting to find out just what effect the installation of a set would have upon production in a room where thousands of small parts are inspected by hand. But in the average shop, where concentration of hand, mind, and eye is essential to production, and where noise is predominant, radio, to my mind at least, has no place.

—ROBERT S. ALEXANDER.

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Should Workers Buy Company Stock?

BEFORE any stock purchasing plan is put into operation, the workers should be educated up to the idea by explanatory notices on the bulletin board and by brief talks before the assembled workers given by an executive.

They should be shown the merits of holding stock in the company, the percentage of dividends as compared with bank interest, and the possible increase in value. But in the matter of subscribing for shares, the worker should do so on his own initiative. Then, when a percentage is taken out of his wages, he will not be inwardly resentful.

It is true that such a course would mean that only a small part of the workers would become stockholders at once. But a good percentage of the rest would come around to the idea when they heard of dividends being declared or of the rise of the stock in yalue. One thing seems to be certain, the stockholders would become better workers.

—BRUCE GORDON.

* * * *

THE · NEXT · TOPIC

"Paying for Dependability"

Picking Men in Cheerful Surroundings

SUMMARY OF THE DISCUSSION

Williams had a room fixed up where the new personnel director could interview applicants. Ed could not see the use of "frills," nor why the company should spend money entertaining men who wanted jobs. Al told him that the psychological value of such a room was considerable and that it gave the men a better impression of the shop.

THE opinions expressed by the various correspondents were generally in favor of an interview taking place amid pleasant surroundings. It was the unanimous opinion that first impressions are important. Men are influenced by their surroundings, it was thought, but the reception given the applicant by the one who interviews him was held equally important.

This was emphasized by a writer who stated that good men were often passed by because the atmosphere of the place was such that the man made no effort to secure employment. Another writer maintained that the desire for a "square deal" was the paramount idea with most applicants, and that they judged largely by their initial reception whether they were likely to get it.

A foreman favored Ed's idea that it was a waste of money to fit up such a room, although he admitted that there were things to be said in favor of it. He held that cleanliness and order were desirable, but beyond that the benefit was doubtful. Still another correspondent advocated taking a skilled mechanic into the shop where he would be in familiar surroundings and would see the actual conditions under which he would work.

ABSTRACTS OF A.S.S.T. PAPERS

The following are abstracts of some of the papers to be presented at the Eleventh Annual Convention of the American Society for Steel Treating at the Public Auditorium, Cleveland, from September 9 to 13

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Behavior of Carbon Tool Steel on Quenching

By G. V. Luerssen

Metallurgical Department, Carpenter Steel Company

CARBON tool steel, while perhaps the oldest steel known to the arts, has probably been the subject of less discussion than any other steel of like importance. While individuals handling tool steels undoubtedly have accumulated valuable information regarding its properties and behavior, still the published literature contains little on the subject. This may indicate lack of sufficient understanding.

The substitution of alloys for plain carbon steels has without question solved many vexing tool problems, but there have undoubtedly been many cases in which alloys have been resorted to needlessly. Such cases are often those in which the carbon steels had produced remarkably fine tools sometimes, while at other times had fallen down badly. The problem in such cases of obtaining uniformly good tools has been attacked by going into alloys, when it might very easily have been solved by securing a uniform, high-quality carbon steel. Furthermore there are many jobs in which carbon steel has been found superior to alloy steels. These are represented notably by the class of tools which require a very hard surface to withstand wear and battering, and a tough interior to withstand splitting. Such conditions are regularly encountered in heading dies, and certain types of shear blades.

Aside from the fact that carbon steels are eminently adapted to certain classes of service, they are often very desirable from the point of view of the tool maker. They are more easily forged than most alloys, easier to anneal, easier to machine, and simple to harden. In many cases they are cheaper, and more readily obtainable from stock. With these many things to recommend their use, there appears to be no question that the improvement of carbon tool steels is a subject worthy of further study.

Every observing user of carbon tool steel has at times noticed variations in its behavior. For many years the workers of steel both in Europe and in this country have used the term "body" in describing certain characteristics of tool steel. While this term "body" has always been more or less a will-of-the-wisp, still it undoubtedly has some meaning, and probably describes some more or less involved condition.

Occasionally, complaints are made that it is impossible to harden tools from certain bars of steel without soft spots. These are commonly referred to as fugitive soft spots for the reason that upon requenching they occasionally disappear, but re-occur in some other portion of the tool or part, indicating that they are not associated with any specific surface condition, but rather result from some inherent property of either the quenching bath or the steel itself. That the character of the quenching bath has a profound effect upon this condition has been shown by Epstein and Rawdon, who were able to produce soft spots at will on casehardened specimens by increasing the gas content of the quenching water. It is undoubtedly true, however, that some carbon tool steels do tend to develop soft spots in quenching under conditions which do not produce them in other steels of the same composition, and while it is true that in practically every case soft spots can be prevented by proper quenching methods, the condition mentioned above represents a variable in the steel which is not desirable.

Steels have been reported, on the other hand, which tend to crack in water hardening more readily than others. These often have a dry, stony fracture even when quenched from as low a temperature as 1430 deg. F. (775 deg. C.). Still other steels are reported to check in grinding more readily than others. Here again there are two variables to consider, the character of the wheel and manner of grinding, and the properties of the steel. It is well known that any piece of hardened steel can be checked by abuse in grinding. But on the other hand, it is true that some carbon-steel tools check more readily than others under the same grinding conditions.

Lastly, it is reported occasionally that some steels change size in hardening differently than other steels of the same composition. While size change may often be traced back to variations in the annealed structure, it is perfectly possible to have these variations in steels annealed to the same structure, and again there appears to be some inherent property of the steel responsible for the variation.

In the course of a research covering about five years conducted for the purpose of developing methods for the manufacture of uniform carbon tool steel, studies were made of all the peculiarities mentioned above, and it was found that within certain limits these are dependent upon two properties of the steel: hardness penetration and quenching range. It was found further that when these two properties were controlled within close limits, the steel gave uniform performance in service. Suffice it to say that the properties to be described depend largely

upon conditions in the melting furnace, and that in order to keep these properties uniform from heat to heat, it is necessary to duplicate in exactly the same way, and time after time, a great many details of the melting operation. This paper will attempt to show how the peculiarities mentioned above are related to the two inherent properties, hardness penetration and quenching range, pointing out the necessity of using uniform tool steel if uniformly satisfactory results in service are to be obtained. But it is also apparent that the quenching method which fits one steel will not necessarily fit the other, and that given a fixed method of quenching, the use of a mixture of both kinds of steel will inevitably lead to hardening room troubles.

Martensite Causes Dimension Changes

Changes in dimensions of tools during hardening are due to the fact that martensite, the hardening constituent in steel, occupies a greater volume per unit weight than do the softer constituents. Consequently, if a cylinder of carbon tool steel of a section which will harden entirely through, be quenched, it will be found of greater length after hardening than before. The behavior of a cylinder, however, which does not harden through is entirely different, and can best be understood by following the various changes which occur, beginning with the heating of the piece.

In heating for quenching, the entire piece expands in length to an extent which depends upon the thermal coefficient of expansion of the steel. Upon quenching, the first portion of the cylinder to contract is of course the outside shell, which upon contracting tends to pull with it the interior portions. These being still hot, and therefore plastic, are actually upset to a shorter length with consequent swelling in diameter. As the piece approaches atmospheric temperature in quenching, an expansion of the surface shell occurs due to the transformation of the outer layers to martensite. No such expansion, however, occurs in the core since softer constituents have already formed in this portion of the piece. After cooling to atmospheric temperature, therefore, the interior portions tend to be shorter than they were in the annealed piece, while the outside shell tends to be longer. Whether the piece as a whole finally shows an expanstion after quenching, or a contraction, depends therefore on the depth of the martensite shell. If the shell is relatively thin compared with the entire section of the piece, the cylinder will show contraction. If it is relatively heavy it may show no change, or actual expansion. It is evident therefore that the properties of the steel effecting hardness penetration will have a marked effect on the change in dimensions of the final tools.

Subsequent changes in length after tempering at increasing temperatures are seen to be fairly uniform, and within limits independent of the steel, the section or the quenching temperature, bringing out the interesting point that the length resulting from the quench determines the length after tempering. Thus tempering cannot correct variations in dimension change, and it is necessary to have uniform changes in hardening in order to insure uniform dimensions in finished tools.

The principles brought out above are very important in connection with the hardening of such tools as taps, in which even slight variations in lead-change in hardening are extremely undesirable. They apply also to the hardening of sectional dies in which the change of size in hardening must be compensated for previous to quenching so that the die will fit after hardening. These are only two of many possible examples which might be cited to show the necessity for uniform change of size in quenching.

Another important point is the possibility of a wide variation in the amount of internal strains set up in quenching. When the behavior of such strains is known, they may be compensated for both in the design of the tool and in hardening, and breakage in quenching or in service can be avoided. However, their behavior obviously cannot be predicted except in steel which behaves uniformly in quenching.

It should be borne in mind that length change in hardening must be considered as distinct from total volume change. The former is dependent upon the shape of the pieces being hardened. For instance, while cylinders which harden with a relatively thin martensite shell will contract in length, they will expand in diameter. A cube of the same material will expand considerably across the middle of the faces, but only slightly on the edge. Volume changes, however, are independent of shape, and only dependent upon quenching temperature and character of material.

It is indicated, therefore, that uniformity in hardness penetration and quenching range is necessary if uniformity in final tools is to be obtained. While overheating should, of course, be avoided, there are still many tools being hardened under circumstances which do not permit a close temperature control, such as those hardened from the forge fire. A heat-sensitive steel will usually give trouble under such circumstances, and often bring from the blacksmith or hardener the comment that the steel lacks body.

The examples used in the tests involve steels of widely different characteristics resulting in widely different tool performance, and were selected so that the results might be easily interpreted. The experience of several years has shown that practically all of these differences can be eliminated through the agencies of a uniform steel and a uniform hardening practice.

Uniform Tool Steel Needed

To summarize, the production of tool steel having uniform hardening characteristics is of advantage to designer, toolmaker and hardener. For the designer it assures a definite and reliable penetration of hardness, making it possible to design his sections in such a manner as to reduce breakage and distortion in hardening to a minimum. For the toolmaker it assures greater uniformity in dimension change, enabling him to make definite allowances for such changes. It also assures for him uniformity of performance in finish grinding. For the hardener it assures constant behavior in heat-treatment, enabling him to standardize more readily his practice. With the introduction of more and more automatic equipment in the hardening room this has grown to be an important factor. It assures him of less breakage in hardening and less trouble in size change. Finally it will afford him a generous factor of safety on most of his operations.

In conclusion it seems evident that only through continued co-operation between the steel manufacturer and the user can the full benefits of carbon tool steel be attained. The manufacturer must supply a uniform tool steel, the user must apply a correct heat treatment to it, to attain the desired result.

Radiography as a Tool in the Metal Industry

By W. L. FINK AND R. S. ARCHER
Research Bureau, Aluminum Company of America, Cleveland

AFTER considering for some time whether the X-ray method of investigation of castings would be practical from a commercial standpoint, it was decided two years ago to install radiographic equipment as a regular adjunct to the production plants of the United States Aluminum Company at Cleveland which are engaged in the manufacture of sand castings, permanent mold castings, die castings, and forgings of aluminum and magnesium. The results obtained have been considered of sufficient value to justify the installation of an X-ray laboratory at the company's new foundry in Fairfield, Connecticut.

It is the chief purpose of this paper to show how the initial X-ray equipment has been used to advantage. To interpret intelligently the features seen in radiographs, it was frequently necessary to correlate these features with evidence obtained by other methods such as machining, fracturing, microscopic examination, and mechanical tests.

The general principles underlying radiography are well known. X-rays travel in straight lines like light and have the property of penetrating matter which is opaque to ordinary light. The absorption coefficient of X-rays is roughly proportional to the density of the material through which they pass. This makes it possible to locate inclusions whose densities differ materially from that of the surrounding medium.

X-rays are commonly detected by the use of a photographic film or fluorescent screen. An example of the first method is found in the familiar dental radiographs. X-rays darken the film so that regions of low density which permit more X-rays to pass appear dark on the negative in comparison with regions of high density. Thus cavities in teeth or voids or gas inclusions in metal specimens appear as dark spots on a radiograph. X-rays illuminate the fluorescent screen so the reverse effect is obtained. In the familiar practice of examining the human body with the assistance of the fluoroscope, dense structures such as bone appear dark.

The fluorescent screen has advantages in speed and economy, but its use in metal radiography is limited by several considerations. In the first place, since the effect is almost instantaneous, the screen does not have the power of integrating X-ray energy as a film emulsion does, so it is necessary to have much greater quantities of X-ray energy pass through the specimen. This naturally limits the thickness of material that can be penetrated. Secondly, the sensitivity of the fluoroscope method is much less than that of the photographic method. The actual ratio of sensitivity varies from one case to another, but in general it may be said that the photographic method is from 5 to 30 times as sensitive as the fluoroscopic method. Another consideration is that the fluoroscope does not provide the permanent record which is provided by photography and which is often desired. Finally, there are certain elements of danger involved in the exposure of the human body to X-rays. It is easy to avoid such exposure in taking photographs, but not so simple with the fluoroscope.

Radiography is fundamentally very similar to contact printing in ordinary photography. The ordinary print and the radiograph are both shadowgraphs. In one case the light rays are absorbed by the silver grains in the emulsion of the negative, and in the other the X-rays are absorbed by the atoms of the specimen. As pointed out above, voids or gas inclusions in a metal specimen will absorb less energy from the X-ray beam than will the metal around them and corresponding dark spots will be obtained on the radiograph. On the other hand, a relatively dense iron or copper segregate in an aluminum alloy specimen will absorb more energy from the X-ray beam than will the metal around it and a corresponding light area will be obtained on the radiograph.

In printing, however, conditions are ideal as compared to those of radiography. For example, the negative is thin and flat so that it can be held in close contact with

Lead-lined X-ray room at the Fairfield plant of the U. S. Aluminum Company. The casting being X-rayed is shown under the machine at the right. The operator looks through the small window at the left

the printing paper, insuring a clear print even with diffused light. On the other hand, radiographic specimens are of appreciable thickness and of various shapes so that many sections are often several inches from the film. This causes a loss of definition, the extent of which depends upon the relative size and location of the focal spot.

The exposure time is one of the factors in determining the cost of radiographic inspection. Consequently it is advisable to decrease the exposure time provided a satisfactory radiograph can still be obtained. With high voltages the exposure time can be reduced and the quality of the radiograph improved at the same time by the use of lead screens. Lead foil is placed in contact with both sides of the film. The screen on the tube side of the film acts as a filter screen and both act as intensifying screens. That is, the lead absorbs energy which would otherwise pass through the film without affecting the emulsion and converts much of it into longer wave length X-rays or into the kinetic energy of photo-

electrons. In these forms the energy is absorbed to a much greater extent by the film. There is on the market a cassette with lead screens on both sides of the film.

Other methods of decreasing the exposure time decrease somewhat the quality of the radiograph but they are sometimes advisable and in the case of thick specimens of heavy metals they are indispensable.

Most of the microscopic defects in metals can be revealed by X-rays. Those which are most readily detected are shrinks, blowholes, pinhole porosity, and segregates. Dross and other inclusions are usually detected but may in certain cases escape detection, when the absorption coefficient is nearly the same as that of the metal. Fine cracks and laminations in forgings can be revealed easily, provided the X-rays pass through the piece nearly parallel to the crack of lamination. However, if the X-rays pass through the piece normal to the plane of the lamination or crack, there is no indication on the radiograph that such a defect exists.

Radiography has proved a most useful tool in the development of welding methods for aluminum castings. Welds of this kind are good enough to be used in some cases in repairing highly stressed castings. Tensile tests, examination of fractures, and microscopic examination were used to supplement the X-ray examination of these bars.

Radiography is a rather expensive method of inspection, and consequently it is seldom used for 100 per cent inspection. There are, however, a few special cases in which X-rays have been used to advantage for routine inspection. For example, a manufacturer of Diesel engines was interested in using aluminum connecting rods but felt that the production on the particular engine in question was not sufficiently great to justify the expense of a forging die. On the other hand, these rods were subjected to severe service conditions and it was felt that the possibility of casting defects in some of the rods would ordinarily eliminate aluminum alloy sand castings from consideration. It was found that sand-cast, heat-treated aluminum alloy connecting rods which were selected on the basis of 100 per cent X-ray inspection were entirely satisfactory.

It has also been found that the inspection of an occasional casting taken at random from the general production will occasionally find defects due to inadvertent changes in foundry practice which were made after a satisfactory technique had been worked out. This is particularly true if the casting has been out of production for some time.

High-Quality Samples Necessary

In developing heat-treatment and methods of forging or rolling, it is desirable to have for experimental work samples of a uniform high quality. In this case more than the required number of samples are made and all of them are X-rayed and even those which have slight defects are discarded. This eliminates at the beginning certain factors which might otherwise vitiate the results of the experiment.

As a result of Dr. H. H. Lester's well-known work at Watertown Arsenal, he concluded that the most important use of radiography is in the development of satisfactory fabricating methods. The experience in this laboratory has confirmed his conclusion. In the case of dies or permanent molds, it is slow and expensive to make changes in the method of gating. In the case of sand castings, however, several methods of gating and chilling the castings can be tried in a short time at a relatively low cost. In the case of heavily stressed parts, break-down tests are made on sample castings with the loading as nearly as possible like that which the castings are to receive in service. This locates the points of maximum stress and particular attention is paid to these areas. Gates, risers, and chills are so located and proportioned that the soundest and strongest metal will occur at the point of maximum stress. In some cases the breaking load for the castings which are shipped to the customer is 50 per cent greater than that of the first casting produced.

Radiography an Aid in Trimming

At times, difficulty has been encountered in trimming certain aluminum-copper alloy sand castings due to the fact that they rapidly dulled the band saws. Prior to the installation of X-ray equipment, specimens from the gates and risers from these castings were examined under the microscope but no abnormality was discovered. The saws had been examined and no defects were found. After the X-ray equipment was installed similar risers were X-rayed and small segregates were located here and there through the section next to the saw cut. After locating them in this manner it was easy to polish a section through a segregate and identify it. The segregates consisted principally of a hard and brittle iron constituent in an aluminum matrix.

In a few sand castings with intricate coring X-ray examination has proved valuable in determining whether or not all core sand and core wires have been removed.

The field of advantageous use of radiography in the metal industry is determined, of course, by balancing the costs against the benefits obtained. An analysis of the costs of making radiographs including all items (depreciation, labor, materials, rent, taxes, heat, light, insurance, telephone, telegraph) shows that the cost has been approximately two dollars per square foot of film. These figures are for an average monthly use of 200 sq.ft. of film.

In the case of small parts it is frequently possible to put several parts on one 14-in. by 17-in. film, and thus reduce the cost per piece to well below a dollar. This is lower than the cost of the less satisfactory alternative method of sectioning and machining. Another point to be considered is that of time. It is in general much quicker to X-ray a casting than to section and machine it.

Another factor which is far from negligible in determining relative costs is the salvage value of the castings after the examination. In approximately 90 per cent of the cases the first casting presented for examination is satisfactory.

The cost of complete X-ray examination increases with the size of the casting.

In those few jobs where 100 per cent X-ray inspection was used no other form of inspection could have taken its place. The only alternatives would have been to use forgings, which would require making of dies, or to use a higher factor of safety in the design at the expense of performance, and perhaps at greater net cost.

Most of the radiographic work has been done on highly stressed parts, such as airplane parts, brake shoes, and motor parts. In such parts a high standard should be maintained by a thorough check of the method before the parts go into production, and there is no doubt as to the profitableness of X-ray inspection.

Locomotive Forgings

By LAWFORD H. FRY
Metallurgical Engineer, Standard Steel Works Company

SEVERAL factors have contributed to direct attention to the necessity for providing forgings of high quality for locomotives. The trend has been toward locomotive units of larger power, and in some designs this has gone so far that each piston rod and main rod must transmit to the main crank pin a thrust as high as 165,000 lb. Forgings so loaded must have not only size but also quality. Size cannot be increased indefinitely because of limits of weight and constructional requirements. Coupled with the increase in load to be carried has come more intensive service for the locomotives and greater insistence on freedom from engine failures.

Present-day demands are such, that to produce locomotive forgings which will give good results in service the manufacturer must consider a wide range of problems. It is not enough to concentrate on the process by which the forging is shaped out of a block of steel, and then to see that this is followed by a careful heat treatment, so that on inspection the specified tensile properties are obtained. To secure satisfactory forgings, control of the process must begin much earlier. Proper methods must be chosen for the making of the steel. The molten steel must be cast in correctly designed ingot molds. The ingots when cast must be allowed to solidify properly and must be carefully reheated and worked into the billets which go to the forge shop. Correct methods in these preliminary processes are of vital importance to the quality of the finished forgings. In fact, the way in which the steel is handled before it reaches the forge shop proper determines whether or not it can be made into a satisfactory forging.

The majority of steel used for locomotive forgings is made by the open-hearth process. The electric furnace is used for a comparatively small tonnage, but because of certain advantages is becoming increasingly important. It is in principle an open-hearth furnace, the only difference being that the heat for melting and refining the charge is supplied electrically instead of by the combustion of gas or oil.

In the present state of our knowledge the five elements, carbon, manganese, silicon, phosphorus, and sulphur, are all that can be covered by a chemical specification for carbon steel. Unfortunately, although they are important in determining the strength and solidity of the steel, they do not measure completely its quality. It is this which rates steel making as an art and not a science. Further, when the steel is made, a well-made heat and a poorly-made heat may have the same composition so far as the five specified elements are concerned and may be indistinguishable one from the other by existing methods of routine chemical analysis. Yet, in service, one heat may give good and the other very poor results. In the manufacture of high-quality forgings, it is essential to have a skilled and conscientious steel maker controlling the source of supply.

A strong influence on the structure of the forgings is exerted by the conditions under which the molten steel solidifies in the ingot. These conditions which deserve careful consideration are beyond the control of the steel maker except in so far as they are determined by the choice of the size and design of the ingot mold into which the molten steel is cast.

Steel solidifying in the ingot mold does not form a uniform structureless solid like a jelly. It freezes as water does, with crystals forming first at the coldest points and growing gradually as the liquid metal cools. The effect that this method of freezing has on the ingot structure is increased by the fact that the steel contains a number of constituents which freeze at different temperatures.

Another important factor influencing the ingot structure is the contraction or shrinkage of the metal during solidification. In an open-top mold the steel will solidify on all exterior surfaces and the subsequent solidification and shrinkage of the interior will leave a cavity or "pipe" down the center of the top portion of the ingot. This may require the top third of the ingot to be discarded to insure the use of sound steel only.

The first crystals of steel which form at the coldest points on the sides of the ingot are comparatively low in the three segregating elements because these elements raise the melting point of steel. As the first crystals grow they make tree-like forms, called "dendrites" from "dendron," the Greek for tree, and are surrounded by liquid metal higher in sulphur, phosphorus and carbon. As the crystals approach each other, this liquid is entrapped between their branches and solidifies there.

As each layer of crystals is formed at the sides and bottom of the ingot it is slightly higher in sulphur, carbon and phosphorus than the layer outside it, and its formation leaves the liquid metal still higher in these elements. The result is that in the solidified ingot the sulphur carbon and phosphorus content increases progressively from the lower and outside portion which cools first, up to the top central portion which is the last to solidify. In fact, in the zone of final solidification the segregation of the carbon, sulphur and phosphorus will be so high that the steel in this neighborhood will be unusable for quality purposes and a portion of the top of the ingot, the amount depending on the size and design of the ingot, must be discarded.

A survey of the structure of the ingot serves to show that the making of the ingot will influence the character of a forging produced from it. During the mechanical process by which the ingot is shaped to a forging the original crystal structure will be distorted and modified and the shape of the nonmetallic inclusions may be changed but the effect of the original ingot structure will be recognizable in the forging.

The transformation from ingot to forging is brought about by mechanical working of the steel. In the case of the large locomotive forgings there will usually be two steps. The ingot will be rolled or forged to a bloom or billet, and this billet reheated and forged to shape.

Many billets for high-quality forgings are produced by reheating cooled ingots and forging them to billet shape under a steam-hydraulic press. With this practice and with a sufficiently small ingot the forging could be made direct from the ingot at one operation.

Modern specifications are drawn to provide a reduction

of at least three to one from ingot to forging. This has the advantage that in the large driving axles and connecting rods required by modern locomotives the forging manufacturer is not forced to use abnormally large ingots in which the secondary segregation may be excessive.

The great majority of locomotive forgings being put into use in this country today are made from one of five types of steels, namely:

1. Plain carbon steel normalized and tempered.
2. Plain carbon steel quenched and tempered.
3. Carbon-vanadium steel normalized and tempered.
4. Chromium-vanadium steel quenched and tempered.
5. Chromium-nickel steel quenched and tempered.

The two last named quenched and tempered alloy steels are not very widely used. They are used mainly under special conditions where high stresses are to be carried or a high factor of safety provided. The tendency at present is to get away from quenched and tempered forgings for locomotive service. The steels being most widely used are those which will give good physical properties when normalized and tempered. Based on this treatment, modern specifications for carbon-steel forgings are being drawn to require tensile properties from 15 to 25 per cent better than were specified ten years ago.

Normalized and tempered carbon-vanadium steel forgings with carbon 0.35 to 0.45 per cent, manganese 0.75 to 0.90 per cent, and vanadium about 0.18 per cent, owe their strength and high yield ratio to the manganese content while the vanadium ensures satisfactory grain refinement and consequent ductility. When clean and well made, and when properly handled in forging, this steel gives excellent results in locomotive forgings. The addition of vanadium to a well made steel will have a beneficial effect on the properties of the steel, but the use of vanadium does not relieve the steel manufacturer of the necessity for using care in the processes of making the steel. Vanadium and other alloys while improving good steels cannot remove the fundamental defects of poorly made steel. In fact, since alloy steels are destined to be more highly stressed in the heat-treating processes and in service, they require the maximum of care in manufacture to produce good results.

Another normalized and tempered steel that has been coming into prominence recently is a low-carbon 2-per cent nickel with moderately high manganese. This steel has been introduced to secure high ductility. More extended experience with this steel in service is necessary before its usefulness can be given an exact rating, but it promises to be valuable.

All of the steels under consideration require some form of heat-treatment after having been forged to shape, to break up the coarse grain produced by forging.

In choosing any of the special steels in an attempt to correct a definite type of trouble, as for example axle failures occurring in the journal, all phases of the problem must be considered. If the failed axles show thermal cracks it is evident that the lubrication has been faulty and it will be good engineering to correct this service condition by mechanical methods, rather than to attempt to find some special steel which will operate successfully under unnecessarily difficult conditions. Rough service and occasional abuse must be encountered. It is to meet such conditions that the special normalized and tempered steels are being developed. At the present time, there is some difference of opinion as to whether it is better to use a steel with high tensile strength or with high ductility. Both types of steel are being tried.

High-Strength Cast Iron

By E. J. Lowry
Consulting Engineer

When one considers the nomenclature "high-test cast irons," it is apparent that the cast-iron industry has not recognized the possibilities existing in the industry. Instead of varying from the empirical standards it is continuing in the same vein. What is necessary is a new method of classification of the varying types of cast iron. This is apparent when one considers the trade name "semi-steel." This is perhaps one of the most glaring incidences in the cast iron field because it will allow a foundryman to make his product with as low as one per cent of steel in his mixture and as high as one hundred per cent steel melted through his cupola. This is no condemnation of the product, but merely shows the latitude within which this type of cast iron may be made.

The one thought which is most striking would be to classify cast irons under such methods as the S.A.E. designates the various types of steel for definite uses. This would not be an easy matter because cast irons are more complicated in their structure, physical and chemical analysis than steels. If, however, the engineer is to be enlightened as to the possibilities of cast irons, they must be categorically named for him with subsequent listings of what might be expected of cast irons in these classes.

The production of high-strength cast irons from the use of alloys has long been known, but to produce strengths of 60,000 and 65,000 pounds per square inch has led to the use of special melting processes with the subsequent addition of alloys. Such methods have not generally been accepted by foundrymen. Any change in the method of melting requires the revising of the usual production processes. It has been the general thought that alloys may be introduced into inferior irons with the resulting effect that high-strength cast irons will be produced. Such is not the case.

Vanadium has come into considerable play in the production of automotive forming dies. This alloy is used in the range of about 0.15 per cent with nickel, chromium and molybdenum in small percentages. The effect of this combination is to give increased wearing qualities combined with high strength and excellent machinability.

When alloys are properly used in connection with the correct section and analysis it becomes a fairly easy matter to produce high strengths without special processes. This means that when a foundryman has adjusted mix-

tures he can use regular cupola metal and with the addition of one of the known alloys increase the average strength from 28,000 to 45,000 pounds, and even as high as 65,000 pounds. The known alloys are nickel, chromium, molybdenum, vanadium and titanium. These may be used singly or in varying combinations with each other.

The study of physical properties and photomicrographs shows that the tensile and transverse strength of the high-strength cast iron is about 75 per cent greater than the regular iron. Deflection and hardness are about 50 per cent greater, while the structure of the high strength iron is sorbitic with a tendency toward some martensite. The annealing at 950 degrees Fahr. for four hours with subsequent furnace cooling reduces the martensite to sorbite and some of the sorbite to pearlite, thus giving comparable machinability.

Further annealing investigations carried on with the same samples after the first anneal showed little or no improvement in the structural composition nor in the hardness and machinability of the samples. Continued experiments with varying analyses and later heat treatments offer great possibilities for high-strength cast iron.

In conclusion, high-strength cast irons offer possibilities to the gray iron foundryman to not only increase the field of application, but also to regain some of the types of work now being placed in other iron and steel groups. The essential point is that in the present position of development of high-strength cast iron, this material is still in the experimental stages, and further, as it is developed, it will be necessary to classify or grade cast irons according to their merits for the enlightenment of all concerned.

Hot Solutions for Quenching Steels

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EXPERIMENTS described in this report relate to the effect of temperature on the cooling properties of liquids used in the hardening of steels and comprise part of a general study of quenching which has been in progress for some time. This subject is of interest from several points of view. More information than is now available might point the way to further useful applications of different liquids, and should help to establish the limits within which coolant temperatures should be controlled for uniform results; it should also serve to place the time-temperature relations, when quenching steels in hot liquids, upon a firmer foundation.

Experimental methods were used in the tests, and steel cylinders ½ in. in diameter and 2 in. in length, were all quenched from 875 deg. C. (1,605 deg. F.) into coolants moving at 3 ft. per sec. The test cylinders were made of 0.96 per cent carbon steel having a chemical composition as follows: Carbon, 0.96 per cent; manganese, 0.28 per cent; phosphorus, 0.016 per cent; sulphur, 0.028 per cent; silicon, 0.18 per cent.

City tap water was used in the water quenching baths and in the preparation of the sodium chloride brines and the sodium hydroxide solutions. The two latter solutions were made respectively, with ordinary table salt and technical sodium hydroxide, containing 96 per cent sodium hydroxide, 2 per cent sodium carbonate, 2 per cent sodium chloride, and 2 per cent moisture. The concentrations referred to in this report are weight percentages and the quenching was carried out in freshly prepared solutions.

Oil No. 2, which was used in a majority of the oil quenching experiments, is a proprietary product. Its properties were approximately as follows: specific gravity at 15 deg. C., 0.874; flash point, 190 deg. C. (375 deg. F.); fire point, 212 deg. C. (415 deg. F.); initial boiling point, 375 deg. C. (707 deg. F.); final boiling point, which is the equilibrium boiling temperature as determined in a reflux flask under atmospheric pressure, 375 deg. C. (707 deg. F.); and final vapor temperature in the determination of the boiling points, 345 deg. C. (653 deg. F.). Analysis indicated that it is probably a mixture of a naphthene base (mineral) oil and about 3.3 per cent fatty oil.

Oil No. 1 is another proprietary quenching oil and its selection for a few experiments was owing to its reported ability to cause rapid cooling at high temperatures. This oil consists of a mixture of a small amount of a heavy Pennsylvania residuum oil of high flash point with a special distilled Pennsylvania stock of low flash point. Its properties were as follows: specific gravity at 15 deg. C., 0.867; flash point, 193 deg. C. (380 deg. F.); fire point, 216 deg. C. (420 deg. F.); initial and final boiling points (reflux method), 380 deg. C. (716 deg. F.); final vapor temperature in the determination of the boiling points, 355 deg. C. (670 deg. F.).

The fact that temperature increase of the coolant affects the cooling in 5-per cent sodium hydroxide somewhat less than in water may be of distinct advantage in practical heat-treatment and probably contributes in an appreciable degree to the rapidity of cooling in the sodium hydroxide solution.

In liquids which normally decrease in cooling speeds with rise in temperature, a small temperature effect, as in the sodium hydroxide, means a tendency to maintain rapid cooling as well as ability to compensate for deficiencies in circulation which usually tend to raise the effective temperature of the quenching bath. From this point of view, the 5-per cent sodium hydroxide is a more desirable coolant than water.

In general, these center cooling characteristics were a reflection of the conditions at the surface face, although the surface cooling became somewhat more irregular as the temperature of the aqueous solutions approached the boiling point of water.

Rapid cooling of the steel specimens at low temperatures in hot water and the hot aqueous solutions is well recognized and is usually considered to be disadvantageous since steels are least able to deform without cracking at temperatures around 300 deg. C. (570 deg. F.) and so relieve the stresses accompanying the volume changes in hardening.

However, it is difficult to see how the rapid cooling in

hot water could, by itself, cause great difficulty, since the cooling rates are less than those obtaining in cold water, cold brines, and sodium hydroxide solutions in which such difficulties are not important enough to prohibit their use in practical heat-treatment. It seems probable that the danger of cracking in hot water quenching is due to lack of uniform conditions over the surface of the steel during fairly rapid cooling at low temperatures. Evidence of non-uniformity was shown in the original records of the cooling curves, but a much better picture of this situation was obtained by watching and listening to the actual quenching operation.

As the initial temperature of the water bath is increased, somewhat less heat must be taken from the steel to form steam, and it is not unreasonable to assume that more steam will come in contact with, or become attached to, the surfaces of the metal in a given time. Such conditions promote non-uniform cooling, since the action at the contact surfaces between the metal and the coolant, or their products, is probably made up primarily of rapidly repeated cycles of steam generation, momentary attachment of steam to the metal surface, and removal.

In any case, hot water at temperatures of 80 to 100 deg. C. is not a good quenching medium under ordinary conditions. Where somewhat slower cooling is desired than can be secured in water at 20 deg. C. and the oils are too slow, possibilities may be found in hot brines and, more particularly, in the hot sodium hydroxide solutions. The center cooling curves were generally smooth, without abrupt changes in direction, for water at 40 deg. C. and 5-per cent sodium hydroxide at 60 to 80 deg. C. Also cooling times were obtained in the hot sodium hydroxide solutions which were between water and oils at ordinary temperatures.

It should be kept in mind that the cooling curves obtained in aqueous solutions have a somewhat different form than those in the oils, and for this reason short cooling times at high temperatures are not necessarily concomitant with short cooling times to low temperatures. The cooling at low temperatures in oils is generally slower than that in aqueous solutions, and the temperature of the coolant which may give the desired results will depend upon the steel under treatment, its size and shape, and similar conditions.

While water at 60 deg. C., 5 per cent sodium chloride at 70 deg. C. and 5 per cent sodium hydroxide at 80 deg. C. produced a Rockwell hardness equivalent to that obtained from the same coolants at atmospheric temperatures, there were appreciable differences in the structures of the quenched steels.

As has been indicated, the effects of temperature of the coolant on the cooling of the steels quenched in oils were small but opposite to the effects observed in water and the aqueous solutions. The cooling was slightly faster in the No. 2 oil at 100 deg. C. than at 20 deg. C. and this was confirmed by the hardness tests. A similar result was shown in the No. 1 oil, but the changes were somewhat smaller. However, not all oils show increased speeds of cooling with increase in temperature as in the two cases cited.

Present-day hardening practice is based largely upon the use of oils, water, and the more rapid solutions such as sodium chloride brines, sodium hydroxide solutions, and water sprays at ordinary temperatures. There is a large gap between the cooling rates obtained in the customary quenching oils and in water, and this is now usually taken care of by tempering subsequent to hardening by or interrupted quenching. Such procedure is entirely satisfactory for many practical purposes, but simplification and economy and possibly also technical advantages would result if coolants were available to provide a more closely graded set of cooling characteristics.

The liquids discussed offer a graded set of cooling rates from those of water and the more rapid aqueous solutions at atmospheric temperatures to those of the customary oils. The most promising group, selected from the liquids considered, are given in the table in the order of decrease in the speeds, or increase in the times, of cooling. The order given is correct insofar as the hardness, structures and center cooling times from 875 to 200 deg. C. (1,605 to 390 deg. F.) are concerned but not necessarily so for the cooling through other temperature ranges, since the cooling curves of the different liquids do not all have the same form.

The corrosive nature of the hot sodium hydroxide solutions and sodium chloride brines is at the same time

List of Liquids Given in Order of Decrease in Cooling Speeds

Liquid and Temperature	Cooling Time from 875 to 200 deg. C.(1) in Seconds for Surface	Center
More Rapid Than Water		
5 per cent NaOH at 20 deg. C.	0.31	7.8
5 per cent NaCl at 20 deg. C.	0.48	7.4
Water at 20 deg. C.	1.2	8.6
Rates between Water and Oils		
5 per cent NaOH at 60 deg. C.	1.03	8.8
5 per cent NaCl at 60 deg. C.	1.8	11.8
Water at 60 deg. C.	3.2	13.4
5 per cent NaOH at 80 deg. C.	3.1	14.2
Rates Close to or of Oils		
5 per cent NaOH at 85 deg. C.	{5.0}	{17.0}
5 per cent NaOH at 90 deg. C.	{7.0}	{22.0}
No. 1 oil at 20 deg. C.	14.7	28.8
No. 2 oil at 20 deg. C.	19.3	29.7

(1) For 0.96 per cent carbon steel cylinders ½ in. diameter, 2 in. long; liquid moving at 3 ft. per second.
Bracketed values estimated by interpolation.

an advantage and a disadvantage. These solutions would not be easy to handle industrially from the standpoint of either equipment or operators, but the quenched steels are relatively free from heavy scale, and with bath temperatures of 60 to 80 deg. C. or less, will often come out bright. This denotes active scale removal.

The results obtained in these experiments justify the view that some of the hot aqueous solutions can be useful in bridging the gap between the cooling rates obtained with water and oils at ordinary temperatures, but some of their characteristics must be recognized as sources of danger or disadvantage. The maintenance of rapid cooling at low temperatures may be undesirable in the hardening of some steels, but this also applies to drastic coolants such as the cold brines and cold sodium hydroxide solutions now used industrially. Difficulties from this source can be minimized in some cases at least, by removing the steel before it reaches coolant temperatures (interrupted quenching) and under suitably controlled conditions any benefits derived need not be at the expense of high hardness. Another source of danger in the hot aqueous solutions is lack of uniformity, promoted by the formation of relatively large amounts of steam, but this becomes more marked as the bath temperature approaches the boiling point of water and can probably be counteracted through adequate circulation and adjustment of coolant composition and temperature.

Machinability of Metals

Results of the various machinability tests made at the University of Michigan are shown in the tables. These data were determined by measuring the force on a planer tool, the torque and thrust of a ¾-in. diameter drill, the penetration in inches per 100 revolutions per minute, of a ½-in. diameter drill, and the energy in foot-pounds required to remove a chip by milling.

The total force *F* on a planer tool is the value in pounds actually exerted in the direction of cut on the planer tool ½ in. wide when taking a depth of cut of 0.010 in. at a cutting speed of 20 ft. per min. The unit force *U* is the number of pounds exerted on 0.001 square inch of cross sectional area of the chip.

The influence of the material on the "tool life" under standardized conditions, as well as the relation between the material and the "finish" which may be obtained by certain cutting tools, is of real commercial value. Such tests were not included with those described, as there was insufficient material of each type on hand to make it possible to obtain any information of value in respect to the "tool life" factor. It was deemed inadvisable to attempt to include the subject of "finish" in these tests, as there appears to be no way of correlating the finish obtained by a specific tool on one type of metal with that on another. Also, one tool shape might not give a satisfactory finish on all metals. The tables given below are taken from a paper presented by Prof. O. W. Boston at the annual convention of the A.S.S.T., at Cleveland, Sept. 9-13, and are given here for comparative shop use. Additional tables are in the original paper.

Machinability Data for Steels

Material	Brinell Hardness	Force on Planer Tool: Total Lbs. "F"	Force on Planer Tool: Unit Lbs. Sq. In. "U"	Force on Planer Tool: Hp. per Cu. In. per Minute	Torque Ft. Lbs. "T"	Drilling: Thrust Lbs. "Th"	Drilling: Net Hp. per Cu. In. per Min.	Drill Penetration In. per 100 r.p.m.	Milling: Ft. Lbs. per Chip "E"	Milling: Hp. per Cu. In. per Min.
Tool steel	152	2,445	489.0	1.235	40.0	1400	1.442	0.0615	58.02	5.628
0.15 per cent carbon steel	102	2,240	448.0	1.131	24.0	1500	1.228	0.07843	44.574	4.324
0.15 per cent carbon steel	101	1,937	387.4	0.978	32.0	1000	1.152	0.07830	41.850	4.060
0.15 per cent carbon steel	101	2,090	418.0	1.055	33.0	1100	1.19	0.08053	42.450	4.115
S. A. E. 1020	99	1,724	344.8	0.870	32.5	1000	1.170	0.08333	34.965	3.393
S. A. E. 2345	191	1,830	366.0	0.923	30.5	1250	1.10	0.07570	32.910	3.193
S. A. E. 2320	162	1,749	349.8	0.884	28.5	1100	1.03	0.06890	45.090	4.374
S. A. E. 3120	155	1,702	340.4	0.859	30.0	1100	1.081	0.07673	31.956	3.100
Tool steel	155	2,394	478.8	1.209	39.0	1500	1.409	0.0545	50.130	4.860
Die steel	190	1,720	344.0	0.868	29.0	1300	1.046	0.07040	34.005	3.315
Screw stock steel	146	1,760	352.0	0.889	27.5	1000	.981	0.09155	32.025	3.120
Screw stock steel	148	1,737	347.4	0.876	27.0	1000	.974	0.09205	31.50	3.053
Axle steel	145	1,745	349.0	0.881	29.5	1000	1.063	0.07575	36.440	3.532
Axle steel	141	1,754	350.8	0.886	28.5	1000	1.029	0.07942	37.992	3.685
Tool steel	188	2,244	448.8	1.132	37.0	1200	1.333	0.05075	46.050	4.470
Tool steel	189	2,263	452.6	1.142	38.0	1200	1.371	0.05726	45.10	4.375
S. A. E. 1112	196	1,475	295.0	0.745	24.5	1000	.884	0.13477	36.774	3.566
Cast iron	207	1,022	204.0	0.516	17.0	600	.614	0.1863	18.225	1.770

Machinability Data for Nonferrous Metals

Material	Brinell Hardness	Force on Planer Tool: Total Lbs. "F"	Force on Planer Tool: Unit Lbs. Sq. In. "U"	Force on Planer Tool: Hp. per Cu. In. per Minute	Torque Ft. Lbs. "T"	Drilling: Thrust Lbs. "Th"	Drilling: Net Hp. per Cu. In. per Min.	Drill Penetration In. per 100 r.p.m.	Milling: Ft. Lbs. per Chip "E"	Milling: Hp. per Cu. In. per Min.
Unleaded brass	50.9	1,163	232.6	0.5875	30.0	1100	1.081	0.0475	23.81	2.3060
Brass screw stock	60.4	567	113.4	0.2863	8.75	325	0.316	0.42336	12.60	1.2220
Brass screw stock annealed	49.9	581	116.2	0.2937	9.0	300	0.324	0.47566	11.93	1.159
Brass screw stock	105	563	112.6	0.2840	8.5	300	0.305	0.4347	13.10	1.270
Brass screw stock	93	574	114.8	0.2899	6.5	300	0.234	0.3546	10.245	0.9935
Brass screw stock	109	575	115.0	0.2902	8.0	300	0.288	0.3497	11.310	1.0965
Sheet brass	109	587	117.4	0.2962	10.5	450	0.379	0.2620	11.400	1.1060
Sheet brass	65	595	119.0	0.3002	13.0	600	0.47	0.3319	11.289	1.0940
Sheet brass	114	609	121.8	0.3070	11.0	600	0.398	0.2453	12.570	1.2190
Yellow brass	45	557	111.4	0.2816	10.0	400	0.361	0.2446	15.450	1.4995
Red bronze	61	617	123.4	0.3117	10.75	500	0.389	0.3700	10.950	1.0620
Bearing bronze	33.6	379	75.8	0.1915	6.0	200	0.217	0.65325	8.160	0.7920
Bearing bronze	67	503	100.6	0.2541	8.0	250	0.288	0.3283	13.380	1.2975
Manganese bronze	130	750	150.0	0.3789	23.0	1200	0.832	0.0307	16.305	1.5830
Gun metal	74	564	112.8	0.2847	19.0	800	0.685	0.0047	18.480	1.7930
Annealed copper	40.4	1,875	375.0	0.9467	50.0	1400	1.80	0.1249	32.88	3.1875
Nickel "A"	143	3,140	628.0	1.586	65.0	2100	2.34	0.0394	54.360	5.2740
Monel metal	130	3,335	667.0	1.684	41.0	1400	1.475	0.0288	52.17	5.0680
Aluminum alloy	73	648	129.6	0.3270	11.0	600	0.398	0.344	9.345	0.9065
Aluminum alloy	63	552	110.4	0.2790	8.5	375	0.305	0.4586	9.390	0.9118
Dow metal	48	250	50.0	0.1264	5.0	250	0.180	0.4933	6.00	0.5817

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The Graf Zeppelin and Public Opinion

MANY fine tributes have been paid to the commander and crew of the Graf Zeppelin, and to its designers and builders, but perhaps the most significant tribute of all is the attitude of the general public. In almost every circle of the community the completion of its flights with safety to the passengers has been taken for granted.

In the recent round trip from Friedrichshafen to Lakehurst the question uppermost in the minds of most people seemed to be whether or not the Graf was enough faster than the Bremen or the Mauretania to warrant the extra cost of transportation. Similarly, the principal speculation in connection with the remarkable circumnavigation of the earth hinged on the total time compared with that of the record-holding globe-trotters.

When public opinion takes the safety of aerial travel for granted and centers its attention on the time element involved, we may well accept the fact that aviation has arrived.

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What Is Simplicity?

SIMPLICITY and complication are relative terms, and what we call complicated today is very apt to appear simple tomorrow. Some of the first automobiles had all sorts of gadgets on the dash. Oil pumps, gages and what not seemed to offer a complicated mess of things for the driver to look after. Today, we have many more instruments, usually compactly grouped, and think nothing of it. Airplane instrument boards are filled with navigation and some engine instruments in addition to those we use in the automobile. And yet the average pilot is probably not a monumental genius.

Some of us used to hope for automobile engines without the "frills" that crept into the designs, but even the cheapest and most simple engine today has more accessories than we dreamed of fifteen years ago. Fuel filters, oil filters, valve oilers and the like are now common practice.

It is the same with machine tools and other machines as well. Back in the days when we like to think that lathes were operated by "real" machinists, they were cone driven, had a belt feed and change gears for every different thread. Now we train a man in a few hours to handle more levers, motor controllers, and gear shifts than the old-time machinist ever visioned. The new machines can hardly be called simple, yet they are operated by a few simple motions that are easily learned.

We are apt to call oiling systems an added complication. Are they not really aids to more simple operation? If they perform their functions properly, machine operation is made easier, production is increased and the costs correspondingly lowered. While we all admire simplicity of design and construction, it is quite possible that the only true tests are the ease of operation, freedom from breakdown and repair, and the results obtained.

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How About Light for Next Winter?

ALTHOUGH winter, with its short days, is still several months away, it is none too early to consider the problem of proper lighting for both office and factory. Unless we are familiar with the achievements of modern lighting in increasing production and decreasing accidents, it is not easy to realize how far behind the times our own plant may be.

Statistics gathered from many sources by illuminating engineers show increases in output of from 8 to 35 per cent brought about by changes in lighting. The location, the kind, and the intensity of the light all affect results. And while some executives may hesitate to spend money for lighting equipment or to increase their charges for current, especially when it is used but part of the working day, few better investments can be made.

Nor is production the only item to consider. Many industrial accidents can be traced directly to improper or insufficient lighting. Statistics are not as definite as in the case of production, but preventable industrial accidents caused by poor lighting are estimated at 18 per cent of the total. On this basis the services of considerably more than 100,000 men are lost to industry annually and for an entire year. Industry pays a goodly share of this cost through its insurance premiums and in delayed production.

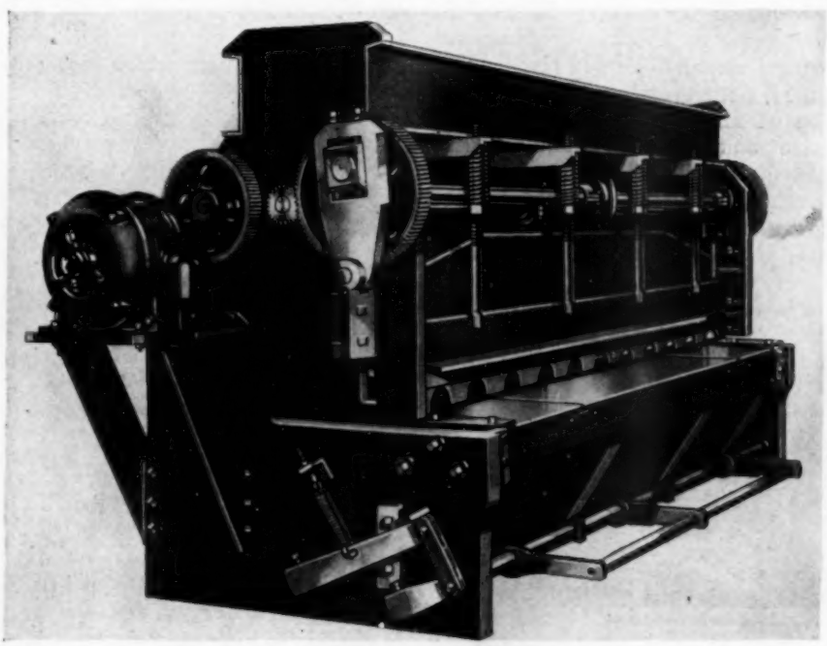
Plenty of light—of the right kind, and in the right place—is a mark of good management.

SHOP EQUIPMENT NEWS

Chicago Overhead-Drive Gap Shear

EMBODYING the all-steel welded construction of the Chicago line of under-drive squaring shears, an overhead-drive gap shear is now being placed on the market by the Dreis & Krump Manufacturing Co., 74th St. and Loomis Boulevard, Chicago, Ill. A feature of the machine is the simple adjustment in the connecting bars for raising and lowering the upper knife bar, an adjustment which is necessary in the change from the shearing of sheets requiring one stroke of the upper knife bar to the shearing of sheets requiring more than one stroke, and vice versa. Proper adjustment is attained by turning the adjusting screws in the bars. Other features claimed by the manufacturer are extra-long front gage arms, side extension squaring gage, wide-range back gage, and automatic back gage operating from one end only and moving parallel with the upper knife bar through mitre gears.

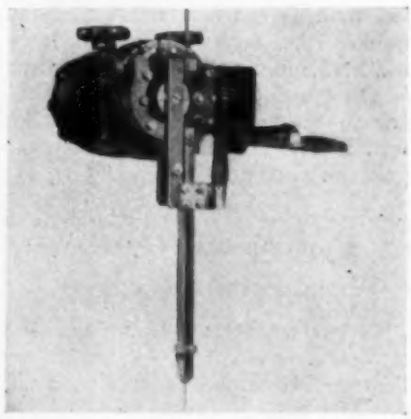
The machine is obtainable either belt- or direct-motor-driven. In the belt-driven type, the belt runs directly upon the flywheel of the machine from the lineshaft or countershaft. Direct-geared motor drive arrangement utilizes a Micarta pinion and a gear train as shown on the illustration. Standard gaps are 18 and 24 in. Special gaps can be furnished. A gap-type shear is utilized for cutting sheets longer than the rated cutting length of the shear by passing the sheet through gaps in the housings after each stroke of the upper knife bar. The shears have an overall length varying from 5 ft. 6 in. to 16 ft. 8 in. for both standard sizes of gap. Weights vary from 3,000 to 45,500 pounds.



Chicago Overhead-Drive, Gap Shear, showing direct-connected motor drive and quick-adjusting connecting bar

Westinghouse Weldomatic Welding Outfit

The Westinghouse Electric and Manufacturing Company is introducing the "Weldomatic," an improved automatic welding outfit, complete with electrode- feeding device, control cabinet, and operator's panel. It is designed to operate either variable-voltage or constant-voltage welding motor-generator sets.



Simplified Weldomatic head, showing electrode feeding device

The Weldomatic has been developed to meet the need for an automatic welder of compact dimensions to facilitate mounting on welding tools, and yet one which equals the usual shop tool in reliability. It automatically strikes and holds an arc between an electrode and the work to be welded without the aid of an operator other than to press the starting button. The feeding device is of compact design which permits its ready application to work-handling tools. The drive motor is mounted in a cylindrical frame which supports the nozzle assembly. The nozzle has adjustments for being moved in two planes, and the nozzle assembly can be reversed to be either right-hand or left-hand.

Compact design is obtained by automatic arc control, permitting the elimination of all clutches, relays, and springs which require delicate adjustment and frequent renewal. Control units are mounted in a cabinet. A small motor-generator set in the cabinet automatically controls the head motor to change its speed and the direction of electrode feed as required by arc conditions. By means of this control, positive striking characteristics, unusual sensitivity of response to arc conditions, and a rate of electrode feed exactly equal to the electrode consumption are claimed. During the welding operation the control motor-genera-

tor set is the only moving part in the control system.

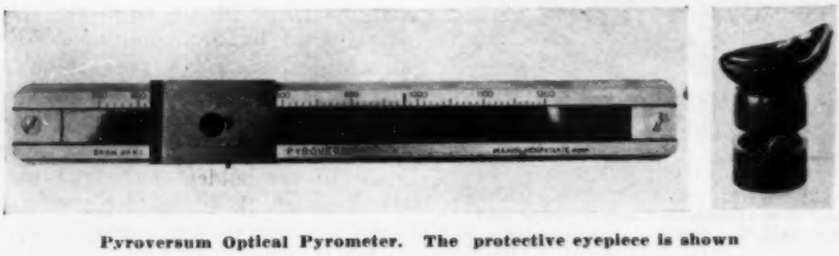
The operator's panel has a "start" and "stop" pushbutton station with large buttons to facilitate its operation with gloved hands. A rheostat controls the arc voltage, which is indicated on a voltmeter. A switch on the panel also permits the operator to reverse the direction of the head motor to retract the electrode from the work under power.

Pyroversum Optical Pyrometer

"Pyroversum" is the name given to an optical pyrometer by the Maco Template & Engineering Co., Ltd., 19 Cursitor St., London, E.C.4, Eng. The pyrometer is suitable for foundry and workshop and may be used for obtaining the heat of molten metals, the temperature of red hot tools, for controlling purposes, and is valuable in many metallurgical and other operations in which determination of the temperature is required.

The instrument consists of a frame 8½ in. long by 1 in. wide which carries a special glass throughout its length. One end of the glass is clear, being gradually darkened throughout its length until at the other end it is practically opaque. On one side of the frame is a scale 5½ in. long, registering from 550 deg. to 1,200 deg. C., or if desired it may be calibrated for Fahrenheit readings. Temperatures may then be read on the scale at the left-hand side of the slide. The scale is calibrated for every ten degrees.

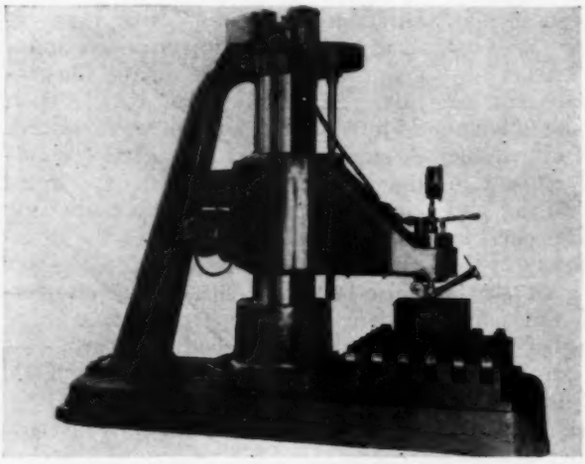
The Pyroversum can be carried about in the pocket, its weight being half a pound. A protective eye-piece is included. Representing the firm, Mr. Charles Mitchell, Cornish Arms Hotel, 311-323 West Twenty-third Street, New York, will show the instrument in this country. A protective eyepiece is used with the instrument, and is shown immediately below.



Pyroversum Optical Pyrometer. The protective eyepiece is shown

Pittsburg Direct-Reading, Brinell Hardness Testing Machine

EMBODYING a direct-reading Brinell head mounted in a radial drill frame and adapted for making Brinell hardness tests on large die blocks and other pieces which are too heavy for regular sizes of Brinell testing machines, a hardness-testing machine is being marketed by the Pittsburg Instrument & Machine Co., 1026 Reedsdale Street, Pittsburg, Pa. A Bickford radial drill was used for the housing and the Brinell head was built into it by the Pittsburg Company, a Wilk direct-reading Brinell instrument being used to give the diameter of ball impressions while the test load is applied. These impressions are shown on a ground-glass plate and the operator takes his readings directly from a graduated glass scale while the test piece is under pressure. The machine is particularly adapted for handling Brinell tests of large die blocks or other pieces because of its radial drill type of construction, allowing a wide range of use. The rolls in the table facilitate handling of the work.

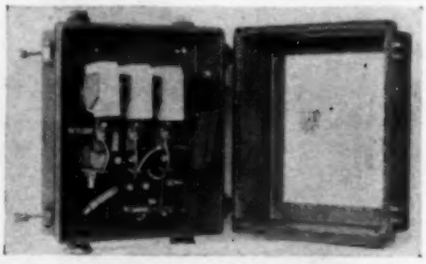


Pittsburg Direct-Reading Brinell Hardness-Testing Machine

Westinghouse Dust-Tight Linestarter

A DUST-TIGHT, weather-proof line-starter is being built by the Westinghouse Electric & Manufacturing Company. It is a remote-controlled, non-reversing, across-the-line type of magnetic starter for single-phase and polyphase squirrel-cage induction motors. This starter is especially adaptable for use in coke plants, cement mills, steel mills, and other places where a dust-tight starter is very desirable.

This starter differs from the other types in its cabinet construction in that a cast-iron cabinet is used with a gasket seal on the door. The conduit is brought in through the top and bottom in threaded openings, so as to make a dust-tight and waterproof connection. All dust-tight linestarters are equipped with the deion grid-type arc quencher, which not only provides for protection against flash-overs under severe operating conditions, but also increases the life of the contacts.



Westinghouse Class 11-200-B3 Dust-Tight Linestarter

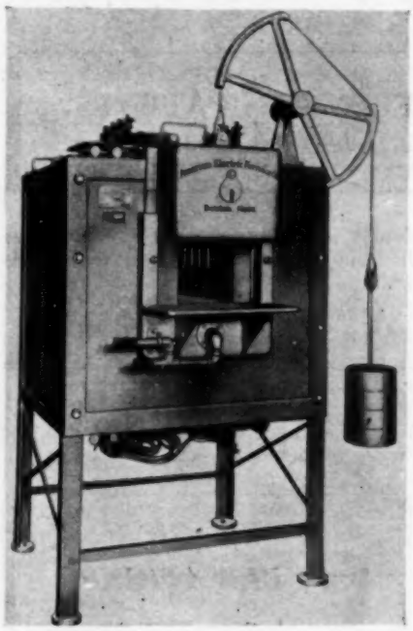
To prevent the operator from breaking the seal whenever the motor is put back in service after an overload, the two small-size linestarters are equipped with an automatic-reset thermal overload relay. This relay

has interchangeable heaters, and accessible calibration lever, and quick make-and-break contacts.

The dust-tight linestarter is now available in three sizes up to 50 horsepower.

American HB Electric, High-Speed Furnace

Showing a patented atmospheric-control feature, an electric furnace for heat-treating high-speed steels will be displayed at the Steel



Model HB-1 American Electric High-Speed Furnace

Treaters' Show by the American Electric Furnace Company, 27 Von Hillern St., Boston, Mass. The furnace has an operating range to 2,500 deg. F. Globar heat eliminators are used, which keep renewed without cooling down the chamber. Terminals are water-cooled. The atmospheric control is provided to prevent oxidation in heat-treating. The manufacturer claims for this furnace correct construction for even heat distribution, elimination of direct, intense radiation, and dependable automatic control. The furnace is obtainable in three sizes with capacities varying from 28 to 60 kw. and hearth sizes from 8 to 16 in. wide, 16 to 30 in. deep, and 8 to 12 in. high. Weights vary from 1,800 to 5,000 pounds.

Pels Regulated-Pressure Eccentric Press

AN ECCENTRIC press with a hydraulic pressure-regulating device is being introduced by Henry Pels & Co., Inc., 90 West Street, New York. The pressure-regulating device will release the pressure automatically as soon as the permissible maximum is reached, which on the machine illustrated is 330 tons. The compression fluid escapes into the overflow tanks, the plunger continues its movement without forcing the ram down any further, and, upon its return stroke, draws the compression fluid back into the cylinder by suction so that the machine can continue work without interruption even after the overload protection device has operated. The manufacturer claims complete protection for the frame of the machine, the gears, shafts and other moving parts by the use of this device, in addition to the possibility of adjustment of the machine to operate at pre-determined amounts of pressure. The machine was first designed for straightening automobile crankshafts, but may be used for a wide range of forging, trimming, forming, coining, and similar operations, as may be desired.

The machine illustrated has a bed 20 x 38 in., a stroke of 12 in., a slide adjustment of 3 in., and a distance of 26 in. between the uprights. The pressure which the machine exerts is 330 tons. The frame of the machine is of steel-plate construction and is guaranteed against breakage.

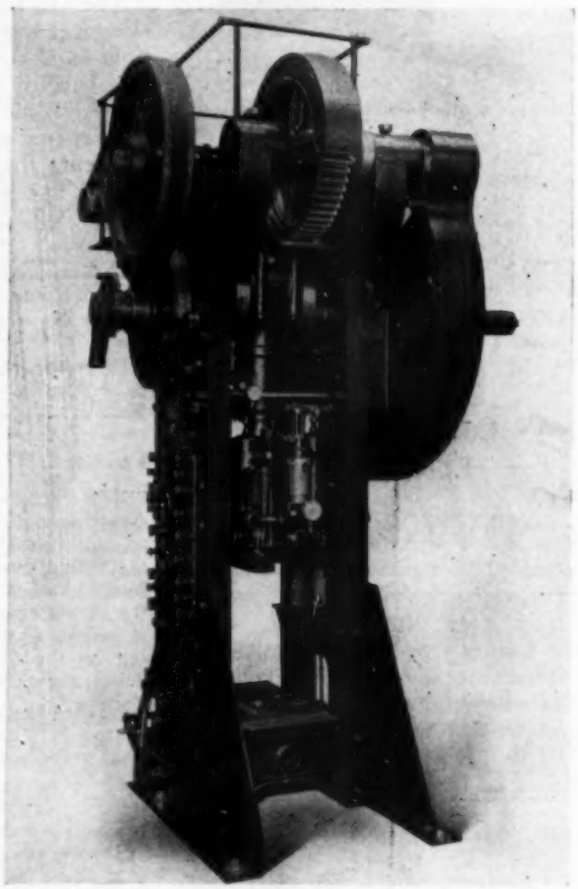


Fig. 1—Pels Regulated-Pressure Eccentric Press, showing the arrangement of the adjustable, hydraulic, pressure-regulation device

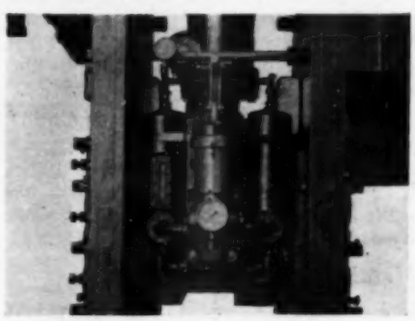
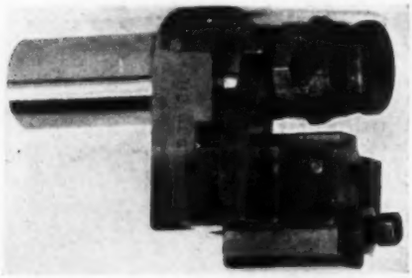


Fig. 2—Close-Up of the Hydraulic Pressure-Regulating Device, Showing Overflow Tanks and Compression Pressure-Indicating Gage

Brown & Sharpe Releasing Die Holder

A releasing die holder, which is recommended for use on automatic screw machines when the thread must be held to a definite length as in threading close to a shoulder, is being manufactured by the Brown & Sharpe Manufacturing Company, Providence, R. I. An adjusting screw on the front of the holder comes in contact with the chuck guard over the nose

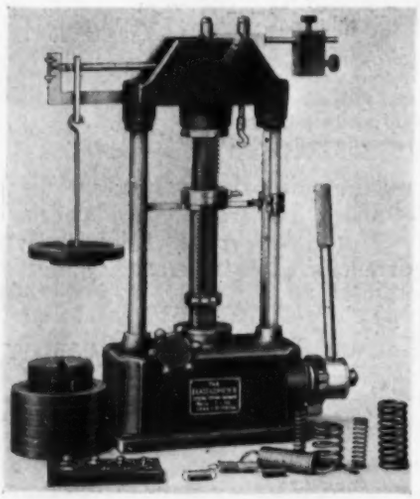


Brown & Sharpe Releasing Die Holder

of the spindle and thus governs the length of threading. This No. OOG holder is for use on Nos. OO and OOG Brown & Sharpe automatic screw machines in connection with acorn dies. The die holder has a capacity of thread diameters between $\frac{1}{16}$ and $\frac{1}{8}$ in. and a length of thread of $\frac{3}{8}$ inch.

Coats Type R-80 Elasticometer

A different design of the pillar type of elasticometer is being introduced by the Coats Machine Tool Company, Inc., 110-112 West 40th Street, New York City, to replace the former type RH-80 elasticometer testing machine of that company. The machine is used for compression and tension tests of springs up to 170 lb. Knife-edges have been cut down in number in the ratio of 3



Coats Type R-80 Elasticometer

to 1 to increase the sensitiveness of the weigher scale, and are made of tool steel, hardened, and ground in position on the machine. The ratio of the scale is still 1 to 10, but this type differs from the old in that this design shows the actual length of the spring in either its compressed or elongated state on the scale attached to the right pillar. The scale is equipped with adjustable tolerance markers.

The tension hook for making elongated tests is shown in the upper right-hand corner of the illustration. The balance weight with adjustment screw in the extreme upper right-hand corner of the illustration is for balancing the machine prior to putting it into operation. The rack is locked with a star-wheel. An adjustable stop, in ring form, to the left of the hand lever may be set to any given length of compression or tension in order to permit the rapid inspection of large quantities of duplicate springs. A balance weight makes allowance for the weight of the spring being tested in tension tests with the machine. The machine may be used for loads varying from $\frac{1}{4}$ oz. to 170 lb. The maximum distances both the compression and tension hooks is 8 in. and the maximum spring diameter approximately $2\frac{3}{8}$ in. The machine requires a space of 22 x 16 x 7 in. and weighs 7 pounds.

REVIEW · OF · RECENT · PATENTS

Relating to the Machinery and Metal Products Industries

Furnaces

The Surface Combustion Co. is assignee of patent 1,716,956 which covers a continuous annealing furnace with main and final heating chambers arranged end to end, a burner firing into the main chamber toward the final chamber, a preheating chamber opening on the main chamber, and having waste gas outlets for gas from the main chamber.

Patent 1,719,888, assigned to the General Electric Co., relates to an electric furnace having bars of refractory insulating material across a heating chamber and a substantially flat sinuous resistor on said bars.

An electric heating apparatus, having a pair of electrodes recessed to receive work, and an adjustable stop for determining the proportion of said work received between the electrodes is covered by patent 1,720,416, assigned to the Chain Belt Company.

George E. Barnhart, of Pasadena, Calif., has been granted patent 1,722,754, relating to a heat-treating and quenching arrangement having means for controlling the rate at which work is dropped from the furnace into the quench tank.

A furnace with a chamber containing heating elements and having a track for an article carrier, among other parts, is the subject of patent 1,723,319, assigned to A. G. Browne, of Baden, Switzerland.

Metal-Working Machinery

A straightening machine, patent 1,716,362, assigned to Maschinenfabrik, A. G., incorporates adjustable standards, roll shafts supported therein, and double-acting thrust bearing with sleeves inclosing liners fitting into the standards.

A metal-forming machine, patent 1,719,446 assigned to the Pittsburgh Screw & Bolt Co., combines with a tool, feed rolls to advance and retract bar stock from the tool, and means to apply a cooling agent to the tool when the bar is retracted.

TRADE PUBLICATIONS

FANS, DRAFT. The American Blower Corporation, Detroit, and the Canadian Sirocco Company, Ltd., Windsor, Ont. have issued bulletin No. 10401 on "Sirocco Forced-Draft Fans for Domestic Heating Plants." The bulletin contains illustrations of uses of the Sirocco fans, together with tables of sizes and other information. The booklet contains twelve, 8½ by 11-in. pages.

FLEXIBLE SHAFT EQUIPMENT. Linick, Green & Reed, Inc., 10 So. Wabash Ave., Chicago, Ill. will issue on September 15, a booklet describing various styles of flexible shaft machines, used in the metal-working industry. About 600 tools will be described and illustrated.

GRINDING. The Hutto Engineering Co., Inc., Detroit, Mich., has issued five booklets numbered consecutively from 137 to 141, illustrating the uses of Hutto cylinder grinders in machines. Booklets are fully illustrated and contain line drawings and phantom views of Hutto grinders and the work which they handle.

NEWS
OF THE WEEK

Eleventh Annual National Metal Congress Opens September 9 at Cleveland

Nearly 300 firms will exhibit products, and many technical papers will be presented

MORE than 275 exhibitors will occupy 80,000 square feet of space at the Eleventh Annual Metal Exposition in the Public Auditorium, Cleveland, during the week of September 9 to 13. The National Metal Congress, which will be held in Cleveland throughout the week, will be under the direction of the American Society for Steel Treating, with the co-operation of the American Welding Society, the Institute of Metals Division of the American Institute of Mining and Metallurgical Engineers, the Iron and Steel Division of the American Society of Mechanical Engineers, and the Iron and Steel Division of the American Institute of Mining and Metallurgical Engineers. The metal exposition will feature the production, selection, inspection, treatment, and welding of metals. In addition to metals, the materials exhibited will include abrasives and manufacturing supplies. Furnaces, tools, control apparatus, and special machines will also be on exhibition. A list of exhibitors will be found on page 394, of this number of the *America Machinist*.

The Congress is expected to attract this year the greatest gathering of metal experts ever brought together in this country. A large number of papers will be presented at the technical sessions of the five societies holding simultaneous meetings at this time. The authors of the papers comprise some of the outstanding names in the engineering fields, experts in numerous lines. On page 391 will be found a complete list of the papers to be presented, together with the names of the authors. Elsewhere in this issue are to be found abstracts of some of the papers of most interest to the metal-working industries. The A.S.S.T. has scheduled a total of ten sessions on each morning and afternoon of the five days of the Congress. W. B. Coleman is chairman of the Meetings and Papers Committee.

One of the extra features of the Congress will be optional visits to various important manufacturing plants in Cleveland. The plant inspections are scheduled for the mornings in order that the afternoons will be free for attendance at the exposition. Inspections scheduled for the week are as follows: Tuesday morning, National Tool Co., Lamson & Sessions Co., Otis Steel Co.; Wednesday morning, Industrial Brownhoist Corporation, Columbia Axle Co., Lakeside Steel Improvement Co., White Motor Co., Warner & Swasey Co., Burdett Oxygen Co., Jos. T. Ryerson & Sons, Inc., Lincoln Electric Co.; Thursday morning, Vlchek Tool Co., Gears and Forgings, Inc., Eaton Axle & Spring Co., Ferro Machine & Foundry Co., National Malleable and Steel Castings Co., American Steel & Wire Co.; Friday morning, National Acme Co., Hupp Motor Car Corporation, Great Lakes Aircraft Corporation, Cleveland Tractor Co., W. S. Bidle Co. On Tuesday afternoon opportunity will be offered to visit the Case School of Applied Science. On page 393 will be found a list of the principal events scheduled for the Congress.

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American World Congress Papers Announced

Titles of American papers to be presented at the World Congress of Engineers to be held in Tokio this November were announced recently by the committee in charge. Papers of particular interest to the metal-working industries are: "Welding and Cutting", "Machinery in the Steel Industry of the United States", "Light Alloys", "American Developments in Diesel Engines", and "Design of American Passenger Automobiles." Seventy-five papers will be presented by the delegation of 200 American engineers at the Congress.

Foreign delegates en route to the Congress are passing through the country at the present time, and special delegations are being appointed to meet them on arrival in New York. Among the delegates arriving in the near future are Carl Koettgen, general director of the Siemens-Schuckert Works; Hans Kralik, representative of the German Ministry of Foreign Relations; and Prof. Oswald Bauer, Director of the German Standards Bureau.

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J. A. Miller, Jr., Heads Electric Railway Journal

John A. Miller, Jr., acting managing editor of *Electric Railway Journal*, a McGraw-Hill publication, has been appointed managing editor. Charles Gordon, editor, has been granted a leave of absence, and Mr. Miller will assume responsibility for the direction of the editorial staff of the publication. Mr. Miller joined the staff of *Electric Railway Journal* in February, 1923, and was appointed acting managing editor on January 1 of this year.

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Good Outlook in Metal-Working Industry Shown in "Business Week" Survey

THAT good conditions have been maintained in the metal-working industry as a whole during the current summer is indicated by reports received from the members of the Council on the Trend of Business, which organization, sponsored by *The Business Week*, is composed of 5,600 leading executives in all lines of business and industry, of whom about 975 are directly interested in the manufacture and distribution of metal products. The volume of business at the close of August in the automobile industry, including the manufacture of parts as well as the distribution of cars, was on about the same plane as at the close of July, and about 1 per cent higher than that at the close of August last year. Business volume in other branches of the metal-working industry at the close of August was about 2 per cent above that at the close of July, and about 7 per cent higher than that at the close of August last year.

The members of the Council intimately connected with the operations of the metal-working industry express the opinion that the general outlook for the next three months is very good. The automobile industry expects to do an average volume of business during the next 90 days about 8 per cent over that at the close of August, and about 8 per cent above that during the same three-months' period last year. In general, manufacturers and distributors of metal products look forward to a good volume of business during the fall.

The improved conditions in agricul-

ture continue to dominate the general economic horizon. Farmers realize that it is too early as yet to gage correctly the value of "The Agricultural Marketing Act," but they seem to feel that the Federal Farm Board will go a long way toward placing the distribution of farm products on a sound basis comparable with the best methods being applied to the distribution of manufacturing products. Other favorable factors on the general business horizon in their order of importance are: continued low inventories and volume turnover; a continued high rate of employment with an even higher rate as the fall season opens; comparatively easy financial conditions; and a continued high consumer purchasing power.

The uncertain outcome of the tariff revision stands out as the most unfavorable factor on the business horizon in the opinion of the members of the Council on the Trend of Business. Until the tariff law is finally passed or rejected a large proportion of American business will be maintained at a comparative standstill. Other unfavorable factors are: the scarcity of money in rural communities, although this condition seems to be adjusting itself; continued stock market gambling on a large scale; a low level of building construction, which, however, is in a better position than for several months; excessive instalment buying, and keen competition engendered by the development of the chain store.

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Annual Safety Congress Scheduled This Month

The eighteenth annual Safety Congress of the National Safety Council is scheduled to be held in Chicago from Sept. 30 to Oct. 4, at the Stevens, Blackstone and Congress Hotels in that city. An exhibit will be held in conjunction with the congress in the Stevens Exhibit Hall. The program for the meeting and schedule of events has been announced in a bulletin recently prepared and sent to the members of the Council. Programs of individual sections, together with names and authors of the various papers to be presented in sectional meetings, are included in the booklet. Henry A. Reninger is president of the Council, and W. H. Cameron is managing director. Further information is obtainable at the headquarters of the National Safety Council, at 108 E. Ohio St., Chicago, Ill.

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Railway Earnings Show Considerable Gain

Railway earnings for the first half of the current year were $563,347,135, a gain of more than $100,000,000 over the earnings of the corresponding period of last year. This income is at the rate of return of 5.54 per cent on property investment, as compared with a return of 4.62 per cent during the corresponding period of 1928.

Gray Iron Institute, Inc., Announces Annual Meeting

The annual meeting of the Gray Iron Institute will be held at the Hotel Cleveland, Cleveland, Ohio, on Wednesday, October 16, according to a recent announcement of the board of directors of the Institute. The entire day and evening will be given over to Institute affairs, including plans for future procedure and discussions on various items of interest. Changes in the by-laws and the selection of the five directors for a 3-year period are items among those to be handled at the meeting. The program includes a group luncheon at noon and the annual dinner in the evening of the meeting day.

* * *

Third Wire Rope Conference to be Held Sept. 13

Invitations have been issued to 200 manufacturers and users of wire rope for the Third Wire Rope Conference to be held in New York on Sept. 13 in the Engineering Societies Building. Brief papers will be presented on the many applications of wire rope in the various fields of engineering and industry. This is the third conference on this subject to be held within six months under the auspices of the A.S.M.E. Research Committee with the assistance of the Engineering Foundation, for the purpose of discussing the desirability of organizing a research committee in the United States to further advance the knowledge of the properties and life of wire rope through a co-operative investigation.

* * *

The autumn convention of the American Management Association will be held at the Hotel Statler, Detroit, from Oct. 29 to Nov. 1. Further information may be obtained by writing the association headquarters at 20 Vesey St., New York City.

* * *

The eighth National Exposition of Power and Mechanical Engineering, more commonly known as the National Power Show, will be held this year at Grand Central Palace, New York City, opening Dec. 2 and continuing throughout the week. The attendance last year was 123,000, with 542 exhibitors.

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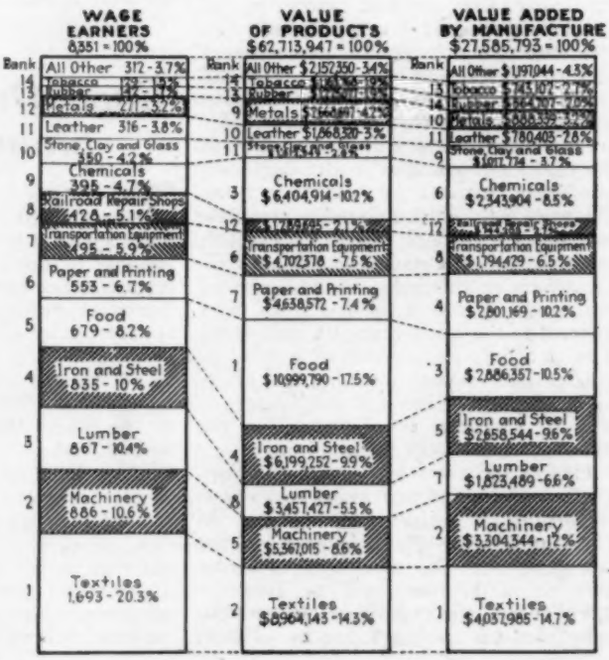
Conference Board Shows Importance of Metal Maufacturing Industry

Nearly a quarter of all wage earners in the country are engaged in metal processing

The machinery industries employed 10.6 per cent of all labor, produced 8.6 per cent of all products by value, and were responsible for 12 per cent of the value added to products by manufacture in 1927, according to a recent survey of the National Industrial Conference Board. In wage earners employed, machinery industries ranked second to textiles, while iron and steel industries rated fourth, transportation equipment seventh, metals industries twelfth, and railroad repair shops eighth, as shown in the accompanying chart. In value of products manufactured, machinery dropped to fifth place, but the machinery industries regained second place in value added by manufacture. Railroad repair shops remained twelfth, and metals fell to tenth place.

The chart shows the relative importance in 1927 of the manufacturing activity of the various industries according to these three distinct methods of measurement. In the first column, the space allotted to any particular industry is proportional to the relation between the number of wage earners in the industry and the


WAGE EARNERS
8,351 = 100%
Bank
All Other 312 - 3.7%
14 Tobacco 129 - 1.5%
13 Rubber 142 - 1.7%
12 Metals 271 - 3.2%
11 Leather 316 - 3.8%
10 Stone, Clay and Glass 350 - 4.2%
9 Chemicals 395 - 4.7%
8 Railroad Repair Shops 428 - 5.1%
7 Transportation Equipment 495 - 5.9%
6 Paper and Printing 553 - 6.7%
5 Food 679 - 8.2%
4 Iron and Steel 835 - 10%
3 Lumber 867 - 10.4%
2 Machinery 886 - 10.6%
1 Textiles 1,693 - 20.3%
VALUE OF PRODUCTS
$62,713,947 = 100%
Bank
All Other $2,152,350 - 3.4%
14 Tobacco $1,661,965 - 2.6%
13 Rubber $1,744,881 - 2.8%
9 Metals $2,644,611 - 4.2%
10 Leather $1,868,320 - 3%
11 Stone, Clay and Glass $1,615,549 - 2.6%
3 Chemicals $6,404,914 - 10.2%
12 $1,378,695 - 2.1%
6 Transportation Equipment $4,702,316 - 7.5%
7 Paper and Printing $4,638,572 - 7.4%
1 Food $10,999,790 - 17.5%
4 Iron and Steel $6,199,257 - 9.9%
8 Lumber $3,457,427 - 5.5%
5 Machinery $5,367,015 - 8.6%
2 Textiles $8,964,143 - 14.3%
VALUE ADDED BY MANUFACTURE
$27,585,793 = 100%
Bank
All Other $1,191,044 - 4.3%
13 Tobacco $745,101 - 2.7%
14 Rubber $754,707 - 2.7%
10 Metals $1,033,339 - 3.7%
11 Leather $780,403 - 2.8%
9 Stone, Clay and Glass $1,011,724 - 3.7%
6 Chemicals $2,343,904 - 8.5%
12 $1,378,695 - 5%
8 Transportation Equipment $1,794,429 - 6.5%
4 Paper and Printing $2,801,169 - 10.2%
3 Food $2,886,357 - 10.5%
5 Iron and Steel $2,658,544 - 9.6%
7 Lumber $1,823,489 - 6.6%
2 Machinery $3,304,344 - 12%
1 Textiles $4,037,985 - 14.7%

total number of wage earners employed. Other columns shown on the chart are determined similarly. The groups differ markedly in the proportion which the value of materials included in the total value of product bear to that total value. If the value of materials be disregarded, as it is in the final column, the share of each industrial group in the value added by manufacture does not correspond with its share in the number of wage earners employed. This fact is noticeable in the machinery and certain other groups in which the equipment of factories is an important element. All figures on the chart are in thousands.

* * * *

Czecho-Slovakian Machinery Industries Continue "Mushroom" Expansion

By Our Paris Correspondent

CZECHO-SLOVAKIAN iron and steel industry passed in 1928 the most prosperous year it has ever known. Owing to the demands upon it in essentially heavy lines, it has developed trade in semi-fabricated elements for the machinery and automobile trades in a satisfactory degree. Export business was an equally favorable factor. The country's exports of manufactured goods of all classes amounted to 65.8 per cent of total exports, whereas such goods imported accounted for but 27 per cent. Czecho-Slovakia's annual production of steel ingots and castings ranks sixth in Europe, before that of Italy, the Saar, Sweden, and Poland. All along the line, figures show a considerable gain over those of 1927.

The metal-transforming industries, at the beginning of 1928, counted 180 principal firms, employing 107,539 workers; these latter increased to 124,064 by the end of the year, indicating increased activity and consequent prosperity.

Here, as elsewhere in many parts of Europe, the machinery trades are closely allied with that of metallurgy. The case is true of France and the great industry established at Le Creusot under control of the Schneiders, as it is precisely in Czecho-Slovakia where the Skoda plant is in close communion with the French Schneiders. Consortium or cartel, or whatever it may be, the Skoda works seek business also in world markets on steel railway sleepers, valve springs for internal combustion motors, electric tool steel, polished sheets, and hoisting and production machinery.

Skoda's headquarters are at Prague, but the organization of today is a fusion of two big machinery plants, that of Skoda-Pilsen and Skoda-Ruston-Bromovsky-Ringhoffer at Prague-Smichov, the latter an outcome of a firm which dates back to 1832, thus giving a respectable and desirable lineage. The Skoda firm proper was founded at Pilsen by Emile Skoda in 1869.

Of the five distinct plants, that of Pilsen is the greatest, covering 1,200 acres and having fifty buildings, and a motive power of 43,000 hp., operating 7,000 machine tools and employing 15,000 workers. Its steel plant produces ingots of all dimensions up to 150 tons, castings of all kinds for ship machinery, locomotives, and similar machinery. Its foundry produces castings in iron, steel, aluminum, and bronze. The forge and rolling mill produces finished and semi-finished pieces from its own raw materials. Its small forgings include screw machinery production and springs of all forms. Its locomotive shops are equipped with the latest models for the building and repairing of locomotives to any specifications.

The automobile plant produces tractors from 50 hp. to 80 hp., motor plows, road rollers, and cream separators, thus indicating a wide range of mechanical production. The gear plant is especially well equipped and has the right to produce the famous Citroen (French) "double chevron" gears. A special department turns out all forms of printing machinery, including high-speed rotary presses.

Skoda's profits piled up to 158,000,000 crowns in 1928, as compared with 128,000,000 crowns the year before. A dividend of 21⅞ per cent was paid. Orders in hand are said to be greater than ever before, providing for two years' operations ahead and employing 30,000 workers.

The second of Czecho-Slovakia's big machinery industries is that of Breitfeld, Danek and Co. at Prague-Carlin, which dates its inception from 1832. It specializes in the production of sugar-making machinery, and, in addition to a large interior market, has also a big overseas trade. It manufactures boilers and prime movers of all systems, locomotives, hydraulic machinery, hoisting and excavating plants, and a line of refractories, cast iron pipe, tin plate and steel sheets.

The Czecho-Moravian Machinery Co., Prague, dates from 1871 and employs 3,500 hands. Since its fusion with the Electrotechnic Co. in 1920, it has a capital of 8 million crowns. It produces sugar refining machinery, mining and metallurgical machinery, locomotives, motor trucks, and agricultural machinery.

The Teplice Machine Co. was founded in 1871 and employs 800 hands. Its production is analagous to the Breitfeld plant.

The machine industry itself is represented by the Prvni Brnenska Strojirenska Spolecnost. Its capital is 80 million crowns. It makes Sulzer-Diesel motors, turbines, machine tools, steam and hydraulic hammers, cutting and stamping machinery and oil-well drilling appliances. Its plant has recently been added to by new land and buildings costing 40 million crowns.

A dozen other minor machine- and tool-manufacturing plants are distributed throughout Bohemia, Slovakia, Moravia and Sub-Catpathia. Numerous plants turn out textile machinery, notably that of the Textile Machinery Co., Krnov, which puts out the American Northrop line of weaving machinery.

The machine-tool industry is extending its output, with firms specializing on lathes, millers, grinders, planers, pneumatic, and hydraulically equipped machine tools for working metals and wood. The leading machine-tool firm is that of J. Kamenicek of Prague. Others of importance are Josef Suchy of Pecky, Fr. Hirsch of Rokycany, O. Podhajsky of Hostivar, Max Hopfengartner of Holoubkof, Arno Plauert and J. Volman of Zebrak.

Electrical machinery production has suffered from outside competition, chiefly German, though the national industry does not complain of any shortage of orders which curtail such capacity production as exists.

The automobile industry has enjoyed unparalleled prosperity for two years past. Production for the year increased 60 per cent, and is not equal to local demand in spite of constantly increasing imports. Production for 1929 is estimated at 20,000 cars. The "Narodni Listy" states that the Czecho-Moravian-Kolben-Danek works has bought an extensive site at Oswiesza for the erection of an automobile plant.

The chief of automobile plants with modern equipment is that of Laurin-Klement, its inventory counting not far from a thousand machine tools, the plant covering twelve acres. It was important before the war and its progress since has been notable.

The second in importance, the "Praga" firm, as it is popularly known, is putting out a car which is beginning to be seen on the highroads of Europe. The firm is a branch of the Czecho-Moravian Machine Co. which dates from 1871, specializing in recent times in general machinery equipment, the automobile branch being a development of 1907 but only in recent times has it been equipped for big run production. With 1,200 workers, its output is increasing from day to day.

The firm of J. Walter & Co., Jinonice, specializes in motorcycles and bicycles and is also producing a car which has given a good account of itself since the first model appeared in 1920. The firm has become a subsidiary recently to General Motors Corporation. The automobile branch of the firm paid a large dividend last year.

The aviation, general tool, and hardware industries are important both in number and in volume. Iron and steel-lacquered domestic and office furniture industries are showing a constant and profitable growth. Screws, bolts, and rivets are produced in twenty odd plants employing a total of 3,000 workers.

BUSINESS BAROMETER

Further gains in total factory output are almost impossible, but impending recessions will probably be moderate

By THEODORE H. PRICE
Editor, Commerce and Finance, New York

NORMALLY, a situation as serious as the Arab uprising in the Near East would have caused a pause in the activity of speculation. But the American markets were unaffected by the week's developments and in Great Britain the apprehension felt over the situation in Palestine was largely offset by Philip Snowden's political triumph at the Hague and the settlement of the Lancashire cotton strike.

This is the best explanation that can be given of the apparent equipoise in prices. The published averages of stock market prices have again advanced to new highs, but, considering commodity prices as a whole, the net change has not been important.

A Cleveland bank has exposed the incompleteness of the stock averages by pointing out that of more than a thousand issues listed on the New York Stock Exchange 614 were actually lower in price on August 21 than on January 2, while only 388 were higher. It is likewise true that almost half of the various groups of stocks classified according to industries are nearer to the year's low prices than they are to its highs.

These are not the characteristics of a bull market, as usually defined, and the facts thus presented are somewhat sobering in their implications. But as long as most of the best known and active stocks are advancing, nothing seems to disturb confidence, and the business outlook at the end of August holds promise of record trade during the autumn and holidays. Industrial production, however, is pretty sure to lag behind the exceptionally high levels of the first half year.

At present, distributive trade is fully up to expectations. Car loadings are above previous years and, as the share of goods moving by truck increases each year, it is clear that the total domestic trade of the country is at a height never before reached.

In industry a slight recession in steel is the principal new development. It is a delayed seasonal occurrence and is moderate in extent. Most manufacturers expect the autumn increase in steel buying to arrive within a few weeks, but production is still so high that the spurt, if it comes, may be less marked than usual.

In automobiles the prospect is much the same. August's output apparently exceeded July's, but stocks of cars in dealers' hands are large and it is idle to expect that further increases will be ordered in a production which is already above normal. It should not be either surprising or disappointing if the output later falls below the corresponding figures for last year.

Building is excellently sustained. The shoe industry admits the improvement which it has long awaited. Many of the cotton mills are curtailing, but demand for goods is better and summer shutdowns are leaving the market in shape to absorb a fuller production, after the doubts concerning the size of the crop and the price of cotton are resolved.

If the prophecies of the industrial forecasters could be summed up they would probably agree that further gains in total factory output are almost impossible, but that recessions during the remainder of the year will probably be moderate and harmless. It is also likely that the confidence with which 1930 is approached, will be in inverse ratio to the total of industrial production this fall, since even the United States is not yet ready permanently to sustain an activity as great as this year's to date.

The grain markets have been somewhat nervous, but they have not yielded much, and cotton has shown impressive strength on the drought reported in Texas and weevil damage in some other parts of the South. Most wheat men believe that if the farmers will only hold they will soon obtain better prices, and if the government cotton estimate, due September 9, confirms some of the bullish crop reports, spinners are likely to abandon their aloofness. But they are traditionally doubting Thomases who wait for the government stamp of approval on crop scares.

Brokers' loans in New York, as reported by the Federal Reserve Board, made another sensational gain of $132,000,000 last week, following an equal increase the previous week. Even some of the most ardent preachers of the "new era" admit that the pace is too speedy for comfort.

That brokers' loans can increase so rapidly at a time when commercial loans are likewise expanding each week, demonstrates the elasticity of our credit system. With the resources of the Federal Reserve System still untouched, the breaking point is not at hand, but it is idle to anticipate any easing of the strain if Reserve Banks must be called on.

The financial situation, and the possibility that the uprising in Palestine may come to involve a larger area, are the only features which appeared to emphasize the need of caution. Our commerce and industry seem to be in such a strong position that they are not likely to be much affected by anything less than a cataclysm on the stock exchange.

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From this page the reader will get a quick picture of current business and industry. The boxed material below is a summary of the letters from regional correspondents of the American Machinist, published in full on the opposite page.

FOLLOWING a period of active business during the early summer, succeeded by a dull two weeks at the end of August, the metal-working industry has entered the fall season with indications of strong demand for its products.

DETROIT, alone, seems to show inactivity. The vacation season was the dullest in two years. Deliveries of equipment ordered are far behind, however, and the fall outlook is more promising. Indianapolis reports a slump in railroad demand, but public utilities are buying, lathes for heavy work are selling well, and a large business seems about to break. In Cincinnati the demand during August was excellent for the season, centering mainly on single new machines for replacement purposes. The Southern district is experiencing a slow but steady business, with considerable demand for textile machinery and a few orders from railroads.

NEW YORK, after a dull two weeks, is beginning an active fall season. Electrical and sheet metal plants are buying well, and a list of 65 new machines, which may cost in the neighborhood of $100,000 total, is out for the General Electric Company. In New England there is a spotty dullness, with electric refrigerator, airplane, radio and machine shops most active, especially in Connecticut. Textile machinery is in moderate demand. Business in Canada is steady. The automotive industry there shows renewed activity, and power plant equipment, and mining and road-building machinery are moving well.

THE INDUSTRIAL REVIEW

Weekly progress of the machinery and machine-tool business

THE following reports, gathered from the various machinery and machine-tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

NEW ENGLAND

New England machine-tool industry has passed through the anticipated dull period and experienced, contrary to expectation, dullness only in spots, or specific industrial centers, the volume of new business holding up to a comfortable level. Connecticut manufacturers have been unusually active for the summer months and new lists have been added with fair regularity. The tendency toward advance buying was apparent through the current week. With no encouragement for better deliveries, buyers are forced to anticipate requirements as far ahead as possible. Back logs are still heavy.

Buying industries during the week included an electric refrigerator manufacturer, two airplane builders, and a radio manufacturer, in addition to several machine shops. Orders for export, which include a variety of machines, are an important market factor. Worcester manufacturers report a good volume of this export business. Manufacturers in that section are at top schedules. The grinding machinery demand is at its height, and brakes are selling well. Small tool sales spurted when the Stevens Walden Worcester Co. held a special auction sale of its stock recently. Textile machine manufacturers are moderately active with some very attractive bookings reported lately.

Yale Brass Castings, New Haven, Conn., has incorporated with a capital of $25,000 to manufacture brass and aluminum castings. The incorporators, all of New Haven, are: Perley Rubin, Rose Rubin and Arthur D. Bride.

CINCINNATI

Machine-tool manufacturers of the Cincinnati district are unanimous in the statement that, considering the season, the August demand was excellent. In the past week, which was the last one of the vacation period, business held to a good level with the great majority and in only a very few cases was it stated that there had been even a slight lull.

Selling agents report that while the week was a quiet one with them from the standpoint of orders booked, it was most encouraging from the standpoint of prospects developed. The market will liven in the early fall, it is predicted, and sales will mount to a good level.

The sustaining feature of the week's market was the sale of single tools and replacements to general machinists and miscellaneous users. The business was well scattered over the country and the requirements of the buyers were well diversified as to sizes and types of tools. Sales to railroads, automobile manufacturers, and other large users were in the main confined to single items. Inquiries flowed in freely during the week, and the great majority of these being for single tools and replacements, with here and there a case where the requirements were two or three pieces of equipment.

CANADA

Machinery and machine-tool manufacturers in all sections of Canada report a continued steady demand for a wide variety of products. Renewed activity in the automotive industry, an unusually heavy demand for mining and road-making machinery, a good volume of orders for power plant equipment, and increased railroad buying are factors which are serving to keep the majority of metal-working plants working at or near capacity. The demand for power plane equipment and electrical supplies is particularly heavy and will continue at a high level for some time to come. Water power undertakings are under way at present which, when completed to their designed capacities, will involve a total installation of 2,000,000 horsepower.

The Sawyer-Massey factories at Hamilton, have just completed a shipment of seven carloads of graders, maintainers, and other road-making machinery destined for British East Africa and South Africa. According to officials of the company, the shipment now in transit is merely a foretaste of further export business.

The large locomotive and car-building plants are fully employed, and according to the plans outlined by railway executives for increased rolling stock, there will be plenty of work to keep these plants busy for many months.

CHICAGO

Closing days of August find conditions in the machine-tool market somewhat spotty. Up to within a week ago, selling was maintained on a level that indicated a fairly even distribution of business among practically all lines of tool production. Now, in some lines a recession has been reported, while in others there has been no let-up in demand. The average, however, has been good, and such falling off as has been noted is regarded as seasonal.

Selling agents and manufacturers' representatives report that while the call for heavy-duty machinery has not kept to the average of the early months of the year, orders for the smaller types of machine tools have increased in volume. New electric equipment installations have been responsible for perhaps the major portion of the orders filled by some producing plants during July and August, the Western Electric Co. being a heavy buyer in this line. Builders of farm machinery and tractors, also, have contributed largely to the satisfactory volume of business that has been maintained during the last two months, and orders from this source still continue to constitute a good part of the general sales total. Deliveries dates are said to be still unsatisfactory. Railroad buying is of small volume.

DETROIT

Detroit is experiencing the dullest period in nearly two years, and sales of machinery and machine tools have dropped off steadily during the past few weeks. At present there are almost no important orders being received, and all of the inquiries are concerned either with relatively small jobs or with future orders.

The general explanation given for the depression is that automobile manufacturers are waiting until the end of the vacation period before making concrete plans for expansion and change. There seems to be a persistent belief among industrial executives and machinery dealers that the fall will be particularly active.

In spite of the inactivity in the machinery field it is nevertheless true that deliveries are still far behind orders in a great many cases. It seems probable, too, that the difficulty of getting deliveries has had an adverse effect on business. In some cases orders have been taken for equipment to be delivered as late as May, 1930, and a great many shipments will not be delivered before March and April.

The year as a whole may be better than 1928 by a wide margin. The first six months of this year were far ahead of 1928, which was an unusually profitable year. General business conditions here are excellent. Employment has maintained a high level, and production in all of the automobile and accessory plants has been maintained.

NEW YORK

After a somewhat dull period the machine tool situation in the New York area has opened up, and inquiries and orders are beginning to come in in greater volume. In general, the demand is well scattered, and inquiries and orders are coming from a wide variety of industries. In most cases the orders are for individual machine tools. There is one large list out, however, from the General Electric Co. This list calls for a total of 65 tools comprising engine lathes, bench lathes, milling machines, grinders, radial drills, shapers, screw machines, and sensitive drills. It is understood that orders will soon be placed on this list. The General Electric Co., in addition, has also placed orders for considerable new equipment during the past week. The sheet-metal industry, like the electrical industry, is likewise in the market for an appreciable quantity of new equipment.

There are no price changes reported. Deliveries of machines still are far behind, and the situation is even somewhat worse than during previous weeks. The vacation influence, which held up orders in the past week or two, has about disappeared, and business is generally brisk. This condition, together with the stimulus to buying that will naturally come with the Machine Tool Builders' Show, indicates that the fall will be unusually busy.

The dealers in used machinery likewise report high activity. Certain dealers have during the past seven or eight months done a record business, and the demand for second-hand machinery is still strong, with prices high, and with high-production equipment difficult to secure.

INDIANAPOLIS

Little variation is seen during the last two weeks in the machinery business here. Most of the manufacturers and jobbers are preparing for a good fall business following a very short period of sales depression which occurred during the last month. Inquiries already are being received from a number of sources, and present indications point to a large volume for fall.

As it is, there are sales being made, particularly in the heavy lathe business. One local factory reports a good domestic business in these tools, and an increasing export business. It has as many orders

booked as it can care for during the next four or five months. The last month has seen, however, a slump in the railroad demand. Some of the roads have been laying off men in the shops, keeping their motive power on the road as long as possible. This is but temporary, and fall should see a marked increase in machine-tool demand from this source.

Already the farm implement factories are putting out feelers against the increased fall production schedules. The present season has been rather good with them and their factory stocks are at a low ebb, necessitating production earlier than usual.

A continued demand for special machinery continues to come from utilities, notably the gas and power utilities. Many large expansions are being made, and replacements are common. There also is an increasing demand from the coal fields for special mining machinery. The sand and gravel producers continue to buy much special machinery, the season in this line having been the best in years.

SOUTHERN DISTRICT

Southern dealers report slow but steady improvement in machinery, tool, and mill supply sales the past two weeks, with the outlook very promising for continued betterment during the next few weeks and considerably better volume during the late summer and fall than during 1928. Unusually good crops were produced in nearly all parts of the southeastern territory, and with satisfactory prices prevaling the section is in fine shape from an agricultural point of view, which is certain to have a favorable effect on the industrial situation in this district.

The textile industry is still placing some fairly good orders for machinery for new mill projects that are under way in the Alabama, Georgia, East Tennessee, and Carolina section, and the outlook is promising for the next two months. Railroads are also still placing a few orders for heavier equipment for new shop projects under way in the Southeast, but this trade is less active than it was during the late spring and early summer months. Comparatively little buying is being done by the lumber, furniture, or other woodworking industries though some improvement has been noted since the early part of August, with outlook more promising than in several weeks, especially in the furniture manufacturing industry.

Some orders are being placed for used or rebuilt equipment by smaller machine shops and service stations, but this business is still rather quiet, nor is the outlook considered very promising. Road building machinery and contractors' equipment has been slowing up the last two or three weeks, and while business is expected to be as good as last year further declines are looked for during the late summer and fall.

* * * *

Machine-Tool Show Will Feature Mechanization of Industry

THE National Machine-Tool Builders' Show to be held in Cleveland, Sept. 30 to Oct. 4, promises to present evidences of the big forward steps made in American industry. The show is expected to be of unusual interest and value, not merely to machine-tool builders themselves, but also to general users of the many types of equipment to be placed on exhibition. Space has been reserved by approximately 250 exhibitors. Manufacturers of materials and industrial supplies, as well as builders of metal-working machines, material-handling devices, and similar equipment, will be represented. In a majority of the cases, equipment will be shown in operation. Some manufacturers plan to run actual, and in some cases, unusual, production jobs on their machines to demonstrate most effectively the type and range of work they will do.

The keynote of the exposition will be the extensive developments recently made in production machinery. At least three exhibitors will display new machines of a highly automatic character for the performance of work that has probably never before been attempted on this kind of equipment. Many of the other exhibitors will also feature equipment that has been vastly improved to fit it for the easier, quicker, and more closely acurate performance of the work for which it is fitted. A primary factor in most of the machines will be the substitution of machine movements to perform steps previously requiring considerable hand work.

Another outstanding feature of the show will be the growing importance attached to the use of new and improved machinery, in other words, the raising of the obsolescence factor to a position of relatively greater weight. The comparatively small part played in the modern shop by regular old-line equipment will be particularly noticeable. While many machines of standard types will be on display, they will in most cases be equipped with special fixtures and attachments which convert them from hand to semi-automatic operation, as above noted. Such machines are fast replacing the old—and strictly standard—types of machines characterizing the shops of even as late as ten years ago. It may be said therefore that the show will characterize the rapid progress which American industry is making toward a state of almost complete mechanization, or the automatic performance of practically all work that can be done on machine equipment.

* * *

Ford to Act as Host To Edison Pioneers

Henry Ford will act as host to the Edison Pioneers at Dearborn, Mich., in October in connection with the celebration of Light's Golden Jubilee. The Edison Pioneers is a name given to an organization formed of Edison's earliest employees who worked with him prior to 1886, with the addition of some of his later employees. Ford is himself one of them, since more than 40 years ago, he worked as an employee of the Edison Central Station in Detroit.

The organization has a membership of about 250. Many men who began their careers in the Edison laboratories now fill important positions.

Metal Products Prices Increase During Year

Metals and metal products are considerably higher than they were a year ago, according to a recent report of the Bureau of Labor Statistics of the U. S. Department of Labor. With the wholesale prices for 1926 considered as a base of 100, the index number for sales of metals and metal products for July, 1929, was 105, a slight drop from 105.1 in June of this year. However, the July, 1928, index number was but 98.6. Iron and steel prices dropped off slightly in July, the index number being 97.9 as compared with 98.2 for June. In July, 1928, the index number was 94.0. Non-ferrous metals showed a decided increase, coming from 92.6 in July, 1928, to 104.8 in June of this year and 105.1 in July. Agricultural implements fell off slightly from July, 1928, decreasing from 98.8 at that time to 98.3 in June of this year, and remained at 98.3 in July. Automobiles increased from 105.1 in July, 1928, to 112.2 in June of this year, and remained at 112.2 in July. Other metal products increased in wholesale price from 96.9 in July, 1928, to 98.5 in June and July of this year.

Business Items

The Hayes-Anderson Motor Co., Ltd., Vancouver, have recently reorganized under the name of the Hayes Manufacturing Co., Ltd. The company commenced operations in 1919 as distributors of motor trucks, but at the beginning of last year decided to manufacture their own line of trucks, specializing on a design most suitable for use in British Columbia. The company is now preparing plans for a factory. J. P. D. Malkin is president.

Construction has been started at the Aero Corporation of California landing field in Los Angeles, Calif., on a new steel hangar, 100 x 90 ft. in size, to have a concrete floor. This hangar is to be exclusively for Pratt & Whitney servicing and overhaul work. Two test stands of a late type, also being erected in connection with the attached shops, are being constructed of steel and when completed will be interchangeable for either Wasp or Hornet engines.

Officials of the Oliver Farm Equipment Co. attended a banquet of 70 salesmen recently at the South Bend (Ind.) division, which includes the Indianapolis and Battle Creek, Mich., branches. The meeting was held at the Oliver Hotel in South Bend. Melvin Ellis of Chicago, president; Walter A. Weed, vice-president, and David Darrah, advertising manager, were among those present.

The General Electric Co. was allotted $7,200,000 of new shares of stock in the Allegemeine Elektrikitaets Gesellschaft, German electrical company familiarly

known as the "A.E.G.", at a general meeting held in Berlin on August 27. Agreements binding both parties were entered into in order that the German company will retain the majority of share capital of the A.E.G. American directors elected to the board at the meeting were Owen D. Young, Gerard Swope, Clarke Mirrior, Arthur Baldwin, and J. Edmonds.

The Dominion Bridge Co., Ltd., has purchased 30 acres of land in Mount Dennis, a suburb of Toronto, and will build a plant to handle Ontario business on the newly-acquired property. Headquarters of the Dominion Bridge Co. are in Montreal where their principal plants are located. The company also has a plant in Vancouver. It is understood that the new plant to be erected in Toronto will cost in the neighborhood of a million and a half dollars.

The Domestic Electric Co., Cleveland, Ohio, a division of Black & Decker, Towson, Md., has consummated the purchase of a group of buildings and a tract of land at Kent, Ohio, containing approximately 140,000 sq.ft. of floor space, in the building, and eight acres of land. Manufacturing operations will be removed from the Cleveland plant of the company to the new plant.

Announcement has been made at Marion, Ind., that negotiations have been opened for the purchase of the Marion Insulated Wire & Rubber Co. by the Anaconda Wire & Cable Co. The transaction, which is expected to be closed in September, will be a $1,000,000 deal.

The Detroit Steel Products Co. has started construction of a $1,000,000 plant to be erected on a 40-acre site approximately two miles north of the company's present factory, on East Grand Boulevard, Detroit. Automobile springs will be manufactured in the new plant.

The Aerotrus Products Corporation, Los Angeles, Calif., has moved both factory and office to 7012 South McKinley Ave., Los Angeles. W. E. Marchant, is president of the company and A. W. Storms is vice-president.

The American LaFrance & Foamite Corporation, Elmira, N. Y., is moving the Utica, N. Y., offices and plant of the company to Elmira.

The Commercial Tool Co., Cleveland, has been appointed by the Demco Drilling Machine Co., Cleveland, as exclusive agents for the Cleveland territory.

Personals

FRANK D. BREBNER, for many years in charge of the Newcastle, Ind., plant of the Chrysler Motor Corporation, has been transferred to the staff of K. T. Keller, vice-president and general manager at Detroit. The direction of the Newcastle plant will be under E. S. CHAPMAN, who goes there from the manufacturing division of the Detroit office.

E. W. DUSTON, formerly sales engineer for the E. W. Bliss Co., Salem, Ohio, has accepted a position with the Kent Machine Co., Cuyahoga Falls, Ohio, as mechanical engineer, developing new machinery.

ROBERT F. ELDER, Berlin, N. H., winner of the first prize of $1,000 in the Alvan T. Simonds economic contest for 1928, with his essay on the subject "Reducing the Costs of Distribution", has been appointed instructor in marketing at the Massachusetts Institute of Technology as a result of the publication of his prize-winning essay.

WILLIAM TYLER BALL, formerly connected with the Deere Harvester Works, Moline, Ill., on the engineering staff, has accepted a position as sales engineer with the Burgess-Parr Co., Moline, Ill. Mr. Ball will specialize in foundry products, including brass, bronze, aluminum, and special alloy castings.

AUGUST TUECHTER, president of the Cincinnati Bickford Tool Co., celebrated his sixtieth birthday on August 15. Employees of the company replaced Mr. Tuechter's old office furniture with new as an expression of their esteem on his birthday.

ANDREW YATSKO has been appointed general superintendent of the Oakland, Cal., works of the General Electric Co., to succeed J. R. Auguston, who has resigned, it has been announced by C. C. Chesney, vice-president of the company.

E. S. GRANT, formerly assistant general sales manager in charge of the Eastern District for the Dodge Manufacturing Corporation, Mishawaka, Ind., has been appointed general sales manager.

F. E. MEREDITH, Montreal, has been elected a director of the National Steel Car Corporation, Ltd. Mr. Meredith is a director of several other large Canadian industrial concerns.

RALPH R. RUGHEIMER has been appointed a member of the Atlanta branch sales office of the Wagner Electric Corporation, St. Louis.

Obituaries

COLONEL ABRAHAM G. MILLS, vice-president of the Otis Elevator Co., died on August 26 from heart disease, at Terrace Gables Hotel, Falmouth, Mass. He was 85 years old. Colonel Mills, who was senior vice-president of the company, had been with the organization for more than 50 years, and a vice-president for 35 years. Colonel Mills gained his title in the Civil War.

SERGE BELIAVSKY, former engineering head of all railroads in Russia under the Czar, died in the New Haven, Conn. hospital on August 27. Credited with building 200 miles of right-of-way for his country in the thick of some of the heaviest fighting in the three years that followed 1914, and with a record of handling traffic for the Russian Southwestern Railway, Mr. Beliavsky was general traffic manager of the railroads on the Russian front during the war. He came to this country four years ago and has been working since that time as a $35-a-week rail inspector for the New Haven Railroad.

JOHN J. THEOBALD, Spencer, Mass., former superintendent of the Wire Village plant of the Wickwire-Spencer Steel Corporation, New York, died August 20. He was 69 years of age at the time of his death.

EDWARD BEECH CRAFT, executive vice-president of the Bell Telephone Laboratories, died August 20 at his home in Hackensack, N. J., after an illness of several months.

NICHOLAS NEWMAN, president of the Newman Foundry Co., Kendallville, Ind., died recently at the age of 51.

Forthcoming Meetings

NATIONAL METAL CONGRESS. To be held in Cleveland September 9 to 13. Simultaneous meetings of the American Welding Society, the Institute of Metals Division, American Institute of Mining & Metallurgical Engineers, Iron & Steel Division, American Society of Mechanical Engineers, the Iron & Steel Division, A.I.M.E., and the American Society for Steel Treating. W. H. Eisenman, secretary, 7016 Euclid Ave., Cleveland, Ohio.

NATIONAL METAL EXPOSITION. Eleventh annual, held under the auspices of the American Society for Steel Treating, Cleveland Public Auditorium, Cleveland, Sept. 9-14. W. H. Eisenman, secretary, 7016 Euclid Ave., Cleveland.

AMERICAN RAILWAY TOOL FOREMEN. Annual convention at Hotel Sherman, Chicago, September 11 to 13. C. C. Ziegler, secretary-treasurer, 611 West Washington Blvd., Chicago.

MACHINE TOOL BUILDERS EXPOSITION. Under the auspices of the National Machine Tool Builders Association, Sept. 30 to Oct. 4, in the Public Auditorium, Cleveland, Ohio. Ernest F. DuBrul, general manager, 1415 Enquirer Bldg., 617 Vine St., Cincinnati.

SOCIETY OF INDUSTRIAL ENGINEERS. Sixteenth national convention at Hotel Statler, Cleveland, October 23 to 25. Requests for programs should be sent to S.I.E. national office, 205 West Wacker Drive, Chicago.

AMERICAN GEAR MANUFACTURERS' ASSOCIATION. Semi-annual fall meeting at the Benjamin Franklin Hotel, Philadelphia, October 24 to 26. T. W. Owen, secretary, 3608 Euclid Ave., Cleveland.

THE WEEKLY PRICE GUIDE . . .

Rise and Fall of the Market

AN ACTIVE autumn is foreseen in the market for steel materials, particularly sheets, plates and structurals. In most of the other forms, production is now on the decline. Prices hold throughout the entire steel list. Pig iron prices are low, comparatively, but stocks are limited and with scrap at a premium, the tendency is away from lower quotations. Non-ferrous metals continue in a quiet market. Solder is off ¼c. per lb. (33½c.) at New York warehouses. The upward movement in scrap copper continues, while prices of virgin metal remain unchanged. Scrap lead is down.

(All Prices as of Aug. 30, 1929)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b:

CINCINNATI	
No. 2 Southern (silicon 1.75@2.25)	$17.69@$18.19
Northern Basic	19.90
Southern Ohio No. 2	19.90
NEW YORK—Tidewater Delivery	
No. 2 Southern (silicon 1.75@2.25)	19.50
BIRMINGHAM	
No. 2 Foundry (silicon 1.75@2.25)	14.00@14.50
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	21.26@21.76
Virginia No. 2	24.04
Basic	19.75@20.25
CHICAGO	
No. 2 Foundry, local (silicon 1.75@2.25)	20.00
No. 2 Foundry, Southern (silicon 1.75@2.25)	20.01
PITTSBURGH, including freight charge ($1.76) from Valley:	
No. 2 Foundry	20.26
Basic	20.26
Bessemer	20.76

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb:

Detroit	4.50
Cleveland	5.00
Cincinnati	4.50
New York	5.25
Chicago	4.50@4.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots:

Blue Annealed*	Pittsburgh Mill Base	Chicago	Cleveland	New York
No. 10	2.20	3.35	3.30	3.90†
No. 12	2.25	3.45	3.35	3.95†
No. 14	2.35	3.55	3.45	4.00†
No. 16	2.45	3.65	3.55	4.10†
Black				
Nos. 18 to 20	2.65	3.85	3.70	3.80
No. 22	2.80	4.00	3.85	3.95
No. 24	2.85	4.05	3.90	4.00
No. 26	2.95	4.15	4.00	4.10
No. 28	3.10	4.75	4.15	4.25
Galvanized				
No. 10	2.70@2.80	4.20	4.05	4.05
Nos. 12 to 14	2.80@2.90	4.30	4.15	4.15
No. 16	2.90@3.00	4.40	4.25	4.25
No. 18	3.05@3.15	4.55	4.40	4.40
No. 20	3.20@3.30	4.70	4.60	4.55
No. 22	3.25@3.45	4.75	4.65	4.60
No. 24	3.50@3.60	4.90	4.75	4.75
No. 26	3.65@3.75	5.15	5.00	5.00
No. 28	3.90@4.00	5.40	5.25	5.25

*Light plates. †Up to 3,999 lb.

WELDED STEEL PIPE—Warehouse discounts are as follows

	New York		Cleveland		Chicago	
	Black	Galv.	Black	Galv.	Black	Glav.
1 to 3 in., butt welded	50%	36%	55½%	43½%	54%	41%
2½ to 6 in., lap welded	45%	32%	53½%	40½%	51%	38%

WROUGHT-STEEL PIPE LIST

Size, Inches	List Price per Foot	Diameter in Inches—External	Diameter in Inches—Internal	Thickness Inches
1	$0.17	1.315	1.049	.133
1¼	.23	1.66	1.38	.14
1½	.27½	1.9	1.61	.145
2	.37	2.375	2.067	.154
2½	.58½	2.875	2.469	.203
3	.76½	3.5	3.068	.216
3½	.92	4.0	3.548	.226
4	1.09	4.5	4.026	.237
4½	1.27	5.0	4.506	.247
5	1.48	5.563	5.047	.258
6	1.92	6.625	6.065	.28

SEAMLESS STEEL TUBING—Following net prices are for seamless mechanical tubing, cold drawn, round, .10 to .30 carbon, at New York warehouse in lots of less than 100 ft. or 100 lb:

Thickness—Decimal Fractions	B.w.g. and	Outside Diameter in Inches—¼	⅜	½	⅝	¾	1	1¼	1½
		Price per Foot							
.035"	20	$0.15	$0.16	$0.17	$0.18	$0.19	$0.21	$0.23	
.049"	18	.17	.18	.19	.20	.21	.23	.25	
.065"	16	.19	.20	.21	.22	.23	.25	.27	
.083"	14	.20	.22	.23	.24	.25	.27	.29	
.095"	13	.21	.23	.25	.26	.27	.29	.31	
.109"	12	.22	.24	.26	.27	.28	.30	.32	
.120" or .125"	11	.23	.25	.27	.28	.29	.31	.33	
.134"	10	.24	.26	.28	.29	.30	.32	.34	

MISCELLANEOUS—Warehouse base prices in cents per lb:

	New York	Cleveland	Chicago
Spring steel, light*	4.50	4.65	4.65
Spring steel, heavier	4.00	4.00	4.00
Coppered Bessemer rods	6.05	6.00	6.20
Hoop steel	4.25†	4.00	4.15
Cold rolled strip steel	6.25	6.00	6.10
Floor plates	5.10†	5.30	5.00
Cold drawn, round or hexagon‡	3.60	3.65	3.60
Cold drawn, flat or square‡	4.10	4.15	4.10
Structural shapes	3.30†	3.00	3.10
Soft steel bars	3.30†	3.00	3.00
Soft steel bar shapes	3.30†	3.00	3.00
Soft steel bands	3.75†	3.65	3.65
Tank plates	3.30†	3.00	3.10
Bar iron (2.75 at mill)	3.25	3.00	3.00
Drill rod (from list)	60%	55%	50%

*Flat, ¼-in. thick. †Up to 3,999 lb., ordered and released for shipment at one time. ‡Cold finished steel, shafting and screw stock.

Electric welding wire at New York warehouse— 1/32, 8.35c. per lb.; ⅛, 7.85c. per lb.; 5/32 to ½, 7.35c. per lb.

METALS

Warehouse Prices in Cents Per Pound for Small Lots:

Copper, electrolytic, New York			19.25
Tin, Straits, pigs, New York			49.00
Lead, pigs, E. St. Louis	6.55	New York	8.00
Zinc, slabs, E. St. Louis	6.80	New York	8.25

	New York	Cleveland	Chicago
Antimony, slabs	11.00	12.25	14.50
Copper sheets, base	27.75	27.75	27.75
Copper wire, mill, base	19.87½	19.87½	19.87½
Copper, drawn, round, base	26.25	26.25	26.25
Copper tubing, base	29.25	29.25	29.25
Brass sheets, high, base	23.25	23.25	23.25
Brass tubing, high, base	28.25	28.25	28.25
Brass rods, high, base	21.25	21.25	21.25
Brass wire, high, base	23.75	23.75	23.75

SHOP MATERIALS AND SUPPLIES

METALS—Continued

	New York	Cleveland	Chicago
Aluminum ingots, 99%.....	25.00*	24.30	24.30
Zinc sheets (casks).....	10.50@11.00	11.70	10.11
Solder (½ and ½).....	33.50	32.75	31@34
Babbitt metal, delivered in case lots, New York, cents per lb:			
Genuine, highest grade.....			65.00
Commercial genuine, intermediate grade.....			48.00
Anti-friction metal, general service.....			31.50
No. 4 babbitt.....			12.00

*Delivered.

NICKEL AND MONEL METAL—Price in cents per lb., base, f.o.b. Huntington, W. Va:

	Nickel	Monel Metal
Sheets, full finished.....	52.00	42.00
Sheets, cold rolled.....	60.00	50.00
Strip, cold rolled.....	55.00	45.00
Rods, hot rolled.....	45.00	35.00
Rods, cold drawn.....	53.00	40.00
Tubing	75.00*	90.00†
Angles, not rolled.....	50.00	40.00
Plates.....	52.00	42.00

*Seamless. †Welded.

OLD METALS—Dealers' purchasing prices in cents per pound, f.o.b. cars, depending on quantity offered for sale:

	New York	Cleveland	Chicago
Crucible copper.....	15.50 @15.62½	13.50	13.00 @14.00
Copper, heavy, and wire..	14.25 @15.50	13.00	12.00 @13.00
Copper, light, and bottoms	13.00 @13.50	12.50	11.00 @12.00
Heavy lead.....	5.37½@ 5.62½	6.25	4.75 @ 5.25
Tea lead.....	3.75 @ 4.00	4.25	3.75 @ 4.25
Brass, heavy, yellow.....	8.25 @ 8.75	8.00	8.00 @ 8.50
Brass, heavy, red.....	12.00 @12.50	12.50	11.75 @12.25
Brass, light.....	7.00 @ 7.50	7.50	7.00 @ 7.50
No. 1 yellow rod turnings.	9.50 @10.00	9.00	9.00 @ 9.50
Zinc.....	3.25 @ 3.75	3.25	3.00 @ 3.25

TIN PLATES—Charcoal—Bright—Per box:

	New York	Cleveland	Chicago
"AAA" Grade:			
IC, 14x20.....	$12.10	$11.95	$11.50
"A" Grade:			
IC, 14x20.....	9.70	9.90	9.50
Coke Plates—Primes—Per box:			
100-lb., 14x20.....	6.45	6.10	7.00
Terne Plates—8-lb. Coating—Small lots—Per box:			
IC, 14x20.....	7.75@8.00	7.00	7.50

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.*	$0.10@0.13½	$0.16	$0.15
Cotton waste, colored, per lb.*	.09@ .13	.12	.12
Wiping cloths, washed white, per lb.†	.16	38.00 per M	.16
Sal soda, per lb.....	.02½	.02	.02
Roll sulphur, per lb.....	.027	.03½	.04
Linseed oil, raw, in 1 to 4 bbl. lots, per lb.....	.136	.11	.138
Cutting oil, about 25% lard, in 5 gal. cans, per gal.....	.75	.60	.65
Machine oil, medium-bodied (55 gal. steel bbl.) per gal..	.33	.36	.35
Belting — Present discounts from list in fair quantities (½ doz. rolls) for leather or rubber:			
Leather—List price, 24c. per lin. ft., per inch of width, for single ply:			
Medium grade.....	30–10%	30–10%	35%
Med. grade, heavy wgt...	30%	30– 5%	30%
Rubber transmission, 6-in., 6 ply, $1.83 per lin.ft:			
First grade.....	50%	50–10%	50%
Second grade.....	60%	60– 5%	50–10%

*All waste in bale lots. †100-lb. bales.

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars.....	per lb..	$0.033	$0.0325	$0.0325
Cold drawn shafting...	per lb..	.036	.036	.034
Brass rods.....	per lb..	.2125	.2125	.17
Solder (½ and ½).....	per lb..	.335	.335	.3225
Cotton waste, white...	per lb..	.10@.13½	.10@.13½	.10@.13½
Disks, aluminum oxide mineral, cloth, No. 1, 6-in. dia.....	per 100.	3.60	3.60	3.10
Lard cutting oil.....	per gal.	.75	.75	.65
Machine oil.....	per gal.	.33	.33	.30
Belting, leather, medium.....	off list..	30–10%	30–10%	30–10%
Machine bolts, up to 1x30 in., full kegs...	off list..	50-10%*	50–10%*	50%*

*List prices as of April 1, 1927.

MISCELLANEOUS—Continued

	New York	Cleveland	Chicago
Abrasive materials — Standard grade, in sheets 9x11 in., No. 1, per ream of 480 sheets:			
Flint paper.....	$4.86	$4.29	$4.29
Emery cloth.....	22.93	20.97	20.97
Disks, aluminum oxide mineral, 6 in. dia., No. 1, per 100:			
Paper.....	2.08	2.04	2.04
Cloth.....	3.60	3.59	3.59
Fire clay, per 100 lb. bag.....	1.00	.75	.75
Coke, prompt furnace, per net ton...	Connellsville, 2.65@2.75		
Coke, prompt foundry, per net ton...	Connellsville, 3.75@4.85		
White lead, dry or in oil...	100 lb. kegs....	New York, 13.75	
Red lead, dry.....	100 lb. kegs....	New York, 13.75	
Red lead, in oil.....	100 lb. kegs....	New York, 15.25	

SHOP SUPPLIES

Discounts from new list dated Apr. 1, 1927, applying on immediate deliveries from warehouse stocks in New York and vicinity:

Machine bolts:	
Up to ¾-in. x 6-in., full kegs, list less.....	60%
Larger, up to 1 x 30-in., full kegs, list less.....	50–10%
Less than full kegs or case lots, add to list.....	10%
Fitting-up bolts: list less.....	45%
Lag screws:	
Up to ½-in. x 6-in., list less.....	60%
Larger, list less.....	50–10%
Less than full keg or case lots, add to list.....	10%
Rivets:	
Structural, round head, full kegs, net.....	$4.50
Structural, round head, broken kegs, net.....	6.00
Tank, 7/16-in. dia. and smaller, list less.....	60%
Nuts:	
Hot pressed, square or hexagonal, blank or tapped:	
Full kegs up to 1-in., incl., list less.....	60%
Larger, up to 3-in., list less.....	40–10%
Less than keg or case lots, add to list.....	10%
Washers:	
Wrought, full kegs, per 100 lb., list less.....	$4.00
Wrought, broken kegs, per 100 lb., list less.....	2.00
Turnbuckles:	
With stub ends, list less.....	20%
Without stub ends, list less.....	50%
Chain:	
Proof coil, base, per 100 lb., net.....	$7.10
Cast iron welding flux, per lb., net.....	.40
Brazing flux, per lb., net.....	.80

MACHINE REQUIREMENTS AND INDUSTRIAL CONSTRUCTION

Equipment Wanted

Mass., Milford—G. H. Sherman, Main St.—miscellaneous tools and equipment for proposed repair and service garage on Main St. Estimated cost $50,000.

Mich., Detroit—Dept. of Purchases & Supplies, 735 Randolph St., J. E. Mills, Comr.—15 in. x 6 ft. motor driven silent chain drive bench lathe.

Mich., Detroit—Drayer Tool & Die Co., 4781 West Fort St.—spindle milling machine.

Mich., Detroit—Wolverine Bolt Co., French Rd. and Grinnell St.—machine equipment for the manufacture of bolts and nuts for proposed 1 story, 80 x 300 ft. factory. Estimated cost $75,000.

Mich., Grand Rapids—Hayes Body Corp., 551 7th St. N. W.—machinery and equipment including conveyor system, for proposed 3 story, 75 x 565 ft. factory on Muskegon St. Estimated cost $125,000.

Mich., Muskegon — Venton Steel Sash Co., Sixth St.—equipment for the manufacture of steel sash for proposed 1 story, 60 x 130 ft. factory. Estimated cost $75,000.

Ore., Klamath Falls—Bolsinger Motor Co.—lathes and auto tools for proposed 1 story, 130 x 260 ft. garage at Main and Esplanade Sts. Estimated cost $85,000.

Opportunities for Future Business

Ala., North Birmingham—Lamson & Sessions Co., F. Case, West 85th St., Cleveland, O., awarded contract for a 3 story factory for the manufacture of bolts and nuts, rivets, etc., here. Estimated cost $100,000. Noted May 24.

Calif., Los Angeles—Southern Pacific R.R. Co., 65 Market St., San Francisco, awarded contract for a group of railroad buildings including round house, machine shop, etc. at San Fernando Rd. Estimated cost $124,000. Noted Aug. 29.

Calif., Modesto—Aircraft Industries Ltd, G. L. Bush, 334 Sutter St., San Francisco, plans the construction of an airplane factory on Waterford Rd. here. Estimated cost $60,000.

Calif., San Francisco—U. S. Metal Products Co., 330 10th St., is having plans prepared for a 1 and 2 story, 200 x 400 ft. factory at Third and Williams Ave. Estimated cost $100,000. Ellison & Russell, Pacific Bldg., Engrs.

Colo., Pueblo — Western Air Express, Inc., 117 West 9th St., Los Angeles, Calif., and Mid-Continent Air Express, Kansas City, Mo., plan improvements to airport including hangars, radio station, administration building, underground servicing equipment, etc. here. Estimated cost $150,000.

Conn., Waterbury—Super Service Inc., c/o Fletcher-Thompson Inc., 542 Fairfield Ave., Bridgeport, is receiving bids for a 2 story, 60 x 150 ft. garage on Willow St. Estimated cost $50,000.

Ill., Chicago—Barco Mfg. Co., 1801 Winnemac Ave., awarded contract for a 2 story, 50 x 230 ft. addition to factory for the manufacture of flexible ball joints, power reverse gears, etc.

Ill., Chicago—State Mfg. & Engineering Co., 2756 Fulton St., awarded contract for a 50 x 110 ft. addition to machine shop.

Ill., Chicago — Western Foundry Co., 3634 South Kedzie Ave., awarded contract for two 1 story, 26 x 31 and 57 x 78 ft. additions to factory at 3634 South Kedzie Ave.

Ind., Fort Wayne—Tokheim Oil Tank Co., 1602 Wabash Ave., Fort Wayne, is receiving bids for a 2 story, 30 x 800 ft. factory. Estimated cost $100,000. Pohlmeyer & Pohlmeyer, Central Bldg., Archts.

Ill., Moline—City is having preliminary plans prepared for the construction of an airport including hangars, repair shops, etc. Estimated cost $150,000. R. M. Benell, City Hall, Engr.

Ill., Rockford—Rockford Drop Forge Co., 2031 South 9th St., awarded contract for a 1 story, 85 x 274 ft. forge shop. Estimated cost $150,000. Noted July 25.

Ind., Elkhart—N. L. Smith, awarded contract for a machine shop and service station at 315 North Main St. Estimated cost $46,205.

Ind., Indianapolis—J. J. Madden Co., 1600 North Sherman Dr., manufacturers of furniture, awarded contract for a 1 story, 101 x 114 ft. factory at Denny and 16th Sts. Estimated cost $47,215.

La., Shreveport—Howard Motor Co., awarded contract for the construction of a 2 story automobile sales and service building at Crockett St. Estimated cost $60,000.

Mass., Needham (Boston P. O.)—Clifford & Locke, Chestnut St., awarded contract for a 1 story, 100 x 100 ft. repair and service garage on Chapel St.

Mass., Cambridge (Boston P. O.)—Simplex Wire & Cable Co., 201 Devonshire St., Boston, awarded contract for reconstruction and alterations to plant on Sidney St.

Mass., Springfield—H. E. Angers & Bros., 293 Bridge St., will build a 2 story, 70 x 90 ft. repair and service garage at 102-110 Armory St. Private plans.

Mass., Woburn—City, c/o Kilham, Hopkins & Greeley, 9 Park St., Boston, Archts., is receiving bids for a 2 story high school including manual training department on Montvale Ave. Estimated cost $650,000.

Mich., Grand Rapids—Buick Motor Car Co., G. C. Thompson, 25 La Grave Ave., will soon award contract for a 4 story, 119 x 120 ft. sales and service building on Sheldon Rd. Estimated cost $200,000. Private plans.

Mich., Monroe—Detroit Stoker Co., W. H. Rey, Pres., 3-120 General Motors Bldg., Detroit, plans a 2 story addition to pattern shop here. Estimated cost $20,000.

Mich., Pontiac—Grand Trunk Railway Co., 400 East Jefferson Ave., Detroit, awarded contract for the construction of a round house, machine shop, etc. on Oakland Ave. here.

Miss., Meridian—City and Airport Commission, plan election Sept. 10 to vote $75,000 bonds for the construction of an airport development including hangars, shops, etc.

Mo., St. Louis — Multiplex Display Fixture Co., 918 North 10th St., awarded contract for a 2 story, 96 x 105 ft. factory.

N. J., East Rutherford (br. Rutherford)—Keystone Falicon Press Inc., 32 Ames Ave., awarded contract for a 2 story, 50 x 130 ft. factory at Boiling Springs Ave. and Orchard St. Estimated cost $70,000. Noted June 6.

N. J., Jersey City—J. Goldenberg, 80 Woodland St., Englewood, will build a 1 story, 110 x 220 ft. garage and service station at Bergen and Virginia Aves. here. Estimated cost $150,000. C. Shilowitz, 26 Journal Sq., Archt. Noted Aug. 8.

N. J., Newark—American Can Co., 230 Park Ave., New York, N. Y., awarded contract for 1 and 3 story shops, storage building, etc., on Elizabeth Ave. here. Estimated cost $155,000.

N. J., West New York—A. Hofmann Inc., 635 15th St., is receiving bids for the construction of a 2 story, 100 x 125 ft. plant for the manufacture of hosiery machinery at 629-35 15th St. Estimated cost $50,000. Lockwood Greene Inc., 1 Pershing Sq., New York, Archts. and Engrs.

O., Barberton — Bertsch Motor Co., 211 Wooster Rd., will soon receive bids for the construction of a 1 story garage at First St. and Hopocan Ave. Estimated cost $80,000.

O., Cleveland—Cream Cone Machine Co., J. W. Taylor, Pres., 1874 East 59th St., awarded contract for a 3 story, 57 x 65 ft. addition to factory at 5800 Hough Ave. Estimated cost $50,000. Noted Aug. 22.

O., Cleveland—Crucible Steel Co. of America, F. E. Phelps, Dist. Mgr., 721 Lakeside Ave. N. W., awarded contract for a 1 story, 150 x 180 ft. warehouse and 48 x 114 ft. office on East 55th St. Estimated cost $200,000.

O., Cleveland—Dill Mfg. Co., G. D. Williamson, Pres., 694 East 82nd St., plans the construction of a 1 story factory on Mandalay Rd. Estimated cost $150,000. Architect not selected.

O., Cleveland — Electric Products Co., 1725 Clarkstone Rd., awarded contract for a 2 story, 80 x 90 ft. factory at 1725 Clarkson Rd. Estimated cost $40,000. Noted Aug. 29.

O., Cleveland — John Harsch Bronze & Foundry Co., J. Harsch, Pres., 11612 Madison Ave., plans a 1 story factory on West 121st St. Estimated cost $75,000. Architect not selected.

O., Cleveland—Lindsay Wire Weaving Co., H. L. Lindsay, Pres., 14025 Aspinwall Ave., awarded contract for addition to factory. Noted Aug. 1.

O., Cleveland—Nickel Plate Development Co., Terminal Tower, awarded contract for a 2 story, 50 x 260 ft. warehouse on Orange Ave. Estimated cost $150,000.

O., Cleveland — Newburgh Steel Co., 6318 Rinsman Rd., is having plans prepared for a 1 and 2 story factory. Estimated cost $40,000. G. S. Rider Co., Century Bldg., Archt.

O., Columbus—McClure-Nesbitt Co., J. McClure, Gen. Mgr., 1503 East Main St., awarded contract for a 1 and 2 story, 86 x 165 ft. garage on East Main St. Estimated cost $38,000. Noted Aug. 22.

O., Dayton—Inland Mfg. Co., Coleman Ave. manufacturers of steering wheels, awarded contract for a 1 story, 250 x 600 ft. factory. Estimated cost $500,000.

O., Kent—Kent Machine Co., awarded contract for a 1 story, 70 x 100 ft. machine shop. Estimated cost $40,000.

O., Painesville—Dept. of Highways, R. N. Waid, Dir., Ohio-Hartman Bldg., will receive bids until Sept. 11 for a 1 story, 50 x 120 ft. garage. Estimated cost $20,000. T. R. Ridley, Ohio-Hartman Bldg., Archt.

Pa., Beaver Falls — Standard Steel Specialty Co., awarded contract for a 1 story, 60 x 120 ft. factory on West Mayfield St. Estimated cost $75,000.

Pa., Dravosburg — Airways & Aircraft Co., Farmers Bank Bldg., Pittsburgh, will soon award contract for improvements to airport including hangars, repair shops, etc. at Bettis Field here. K. Franzheim, 345 Madison Ave., New York, N. Y., Archts. Stone & Webster, Union Trust Bldg., Pittsburgh, Supvr, Engr.

Pa., New Kensington—Aluminum Co. of America, will build a 1 story, 130 x 480 ft. machine shop of 9th St. E. S. Fickes, Oliver Bldg., Pittsburgh, Ch. Engr.

Pa., Philadelphia—I. Fishman & Son, 10th and Allegheny Sts., manufacturers of soda fountains, will soon award contract for a 1 and 2 story, 375 x 480 ft. factory at Erie and F Sts. Estimated cost $1,500,000. C. E. Wunder, 1520 Locust St., Archt. Noted July 25.

Pa., Philadelphia — Philadelphia & Reading Co., Reading Terminal, awarded contract for a 1 story, 137 x 325 and 23 x 119 ft. electrical car shop at Wayne Jnuction as part of $20,000,000 electrification program.

Tenn., Memphis—Memphis Garage Co., plans the construction of a 4 story, 67 x 131 ft. garage at Third and Gayoso Sts. Estimated cost $200,000. G. Awsumb, Dermon Bldg., Archt.

Utah, Salt Lake City—Delzell & Kreplin, plans a 5 story, 82 x 165 ft. garage at 33-38 West Broadway. Estimated cost $200,000. S. W. Winburn, Archt.

Wis., Milwaukee—Siebert & Kegler, 230 Wisconsin Ave., Archts., awarded contract for a 62 x 150 x 113 ft. sales and service building on 3rd St. Owner's name withheld.

Ont., Harvey Lane—Steel Co. of Canada, plans the construction of a 1 and 2 story factory for the manufacture of fencing, barbed wire and other wire products. Estimated cost $500,000. Engineers not announced.

Ont., Kingston—Bd. of Education is having plans prepared for the construction of a 3 story technical school including workshops, etc. Estimated cost $300,000. Colin Drevey, 81 Brock St., Archt.

Ont., New Toronto — Anaconda American Brass Ltd., awarded contract for a 2 story service building in connection with proposed $500,000 expansion program. $75,000.

Ont., Renfrew — Renfrew Refrigerator Co., awarded contract for the construction of a 2 story, 78 x 132 ft. addition to refrigerator manufacturing plant. Estimated cost $75,000. Noted Aug. 15.